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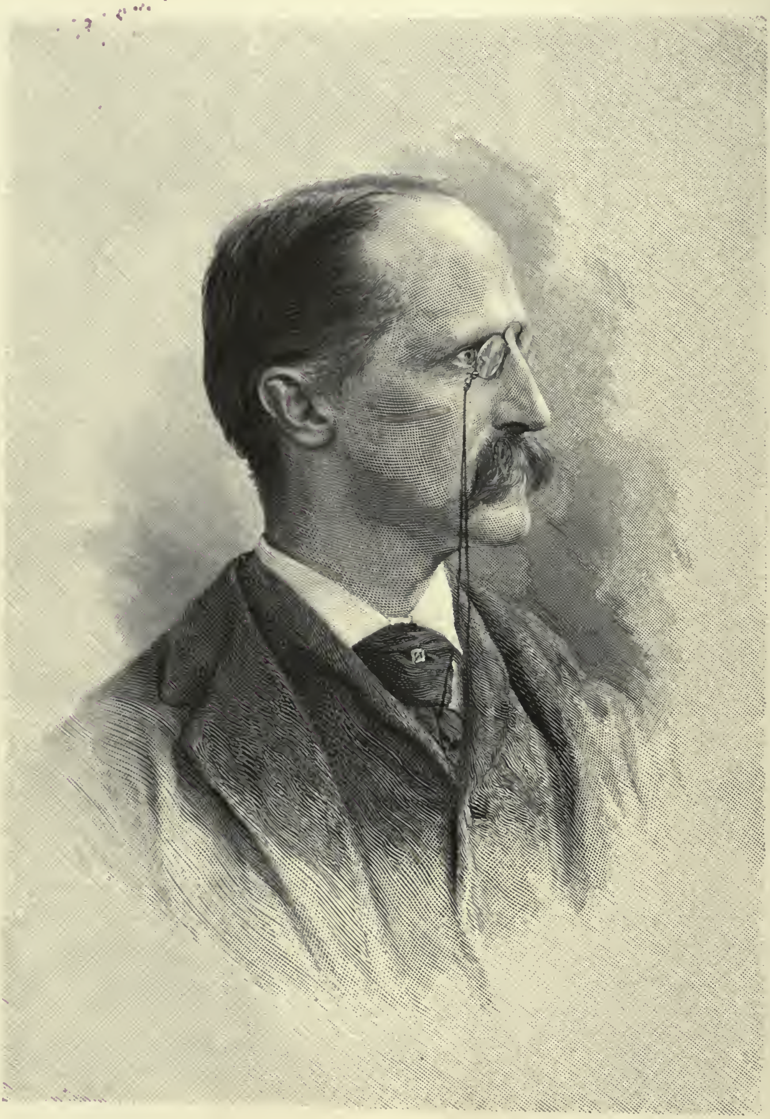

HENRY AUGUSTUS ROWLAND.

APPLETONS'
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MAY, 1896.

NIAGARA AS A TIMEPIECE.

By J. W. SPENCER, A. M., Ph. D., F. G. S.

NIAGARA Falls in History.—Guided by an Indian chief, La Salle and Hennepin visited Niagara Falls in 1678, but it was not until 1697 that Hennepin published his picture of the cataracts, which, in spite of the rude perspective of two centuries ago and the prominence of the *voyageurs*, is famous for having been the first pictorial representation of the falls of Niagara (Fig. 1).

The existence of the falls was known a century and a half earlier than Hennepin's narrative through reports of the Indians to Jacques Cartier (1535). In the early part of the seventeenth century, Champlain and several Jesuit fathers mention the cataract, which was mapped by two of them under the name of "Onigara." Reproductions of Hennepin's picture were frequently made, but there appear to be no fairly good drawings of the falls preserved older than that of Lieutenant William Pierie, of date of 1768 (Fig. 2).

The scenery and even the geology of the Niagara district have been known for nearly half a century, and hundreds and perhaps thousands of papers have been published upon the falls of Niagara. Yet "problems settled in a rough and ready way by rude men absorbed in action demand renewed attention and show themselves to be unread riddles . . . when men have time to think." Even now it is scarcely fifteen years since the history of the falls began to be known.

If we look at a picture of the Falls of Montmorency, near Quebec (Fig. 3), cascading about two hundred and seventy-five feet over the wall of the St. Lawrence almost directly into the river

itself, without flowing through any cañon whatever, and then glance at the gorge of Niagara River, seven miles long, of which only a fragment can be seen in a picture (Fig. 4), the striking difference awakens inquiry. The cause does not lie in either the magnitude of the streams or in the character of the rocks; it is a question of the difference of the age, for Niagara Falls once cascaded from the edge of the mountain wall (Fig. 16) directly into the expanded waters of the Ontario basin just as the Montmorency stream is pouring into the St. Lawrence River to-day.

Early Estimates of the Age of Niagara Falls.—All attempts at reducing geological time to solar years meet with great difficulties, yet Niagara Falls have been used as a chronometer as

Fig. 1.—Facsimile of a View of Niagara Falls by Father Hennepin.

frequently as any other natural phenomenon, and indeed Niagara is perhaps the best measurer that we have. Even at an early date, when the antiquity of the earth was not a popular doctrine, Andrew Ellicott (in 1790) divided the length of the gorge by the supposed rate of recession of the falls, and assigned fifty-five thousand years as the age of the cataract. Forty years later Bakewell reduced the time to twelve thousand years, and a few years afterward Lyell's estimate of thirty-six thousand years became popular and remained so until about fifteen years ago. This method of dividing the length of the chasm by the rate of recession was correct as far as it went, but even the rate was not then known.

Method of Computing the Age of the Falls.—Many years

Fig. 2.—Cataract of Niagara Falls, with the Adjacent Country. (From a drawing on the spot by Lieutenant William Pierie, of the British Artillery, 1768.) This picture was kindly furnished by Peter A. Porter, Esq., of Niagara Falls.

ago Prof. James Hall laid the foundation of all future calculations when he made the first instrumental survey of the crest of the falls. The changes in the crest have been measured three times since, and from these surveys the mean recession for nearly half a century is now known and has been found to be much more rapid than was formerly supposed. If the whole history of the falls of Niagara were thus told, then it would appear that their age is

FIG. 3.—FALLS OF MONTMORENCY. (About 275 feet high.)

about nine thousand or ten thousand years. Indeed, some writers, among others Mr. Gilbert, took this reduced estimate and minimized it to seven thousand years, not knowing or overlooking the history of the river which tells of the changing conditions; but these views he now abandons. The chronometer needed correction. During a term of several years of actual work, but extended through a decade and a half, for the investigations were often blocked with difficulties, the writer has been able to decipher

many phases in the history of the lakes in their bearing upon the growth of the falls, and only after that field work could any attempts at computing the age of the falls be made. A few of the necessary discoveries may be referred to: (*a*) The Niagara River did not drain the Erie basin in ancient times, and consequently there was no ancient river channel ready for the modern stream. (*b*) All the features of the chasm are modern, and only very slightly modified by the older forms of land sculpturing. (*c*) After the birth of the river, Huron and the sister lakes did not empty into the Niagara drainage until comparatively recent times, and therefore, on account of draining only the Erie basin, the volume of the water cascading over the early falls was small. (*d*) Then the descent of the river varied greatly, being for very long ages less than now, and again temporarily much greater. (The observation of the greater height of the falls was made by Prof. G. K. Gilbert, who has followed the writer in the other important points named.) (*e*) The determination of the amount of work accomplished by the falls during each of the episodes of the river seemed the most difficult, but this has been accomplished with partial success. These things have been mentioned to show that the computation of the approximate age of the falls has been a complex question and also one of tedious delays, yet a problem that will continue to awaken interest so long as men endeavor to ascertain the antiquity of the ice age and the correlated antiquity of man. Niagara River is perhaps our best chronometer, and by applying the age of the falls to the deserted shore lines the antiquity of possibly man-inhabited river banks of distant regions and forgotten times will be discovered. Directly the determination of the age of the falls is a stepping stone to the date of the close of the ice age. Under these circumstances the investigations seem to justify the presentation of the results to the general reader, leaving to the essayist the repetitions of the other geographical or picturesque features or the pretty stories of Niagara. Even the great Lyell had no better means of ascertaining the antiquity of the falls than mere conjecture, for a long period of observation was necessary. Strangely, however, his suggestion was not far from the computations based upon our increased knowledge. This coincidence arose from the occurrence of compensating errors, those corrected on the side of reduction of time used alone giving results further from the truth than the mere conjecture, as the varying conditions of the river which increase its antiquity were not known.

SOME MODERN AND ANCIENT FEATURES OF THE NIAGARA DISTRICT.—The map of the Niagara district (Fig. 5) shows a table-land a few feet above the surface of Lake Erie, and extending northward for nineteen miles to the edge of the Niagara

FIG. 4.—THE NIAGARA GORGE BELOW THE WHIRLPOOL.

escarpment, where there is a sudden descent of two hundred and forty feet to the lower plain, that gradually slopes for eight miles farther to the present shores of Lake Ontario, whose waters are three hundred and twenty-six feet below the surface of Lake Erie.

The features of the plain which have a bearing upon the development of the Niagara River are, a low ridge crossing the river just north of the outlet of Lake Erie; a comparatively level plain underlaid by soft rocks, extending thence to near the head of the rapids above the falls, north of which, to the brow of the escarpment, the country rests upon hard limestones, with underlying strata of soft shales and occasional layers of more persisting rocks. These softer shales form the foundation of the country between the end of the gorge at the brow of the mountain near Queens-

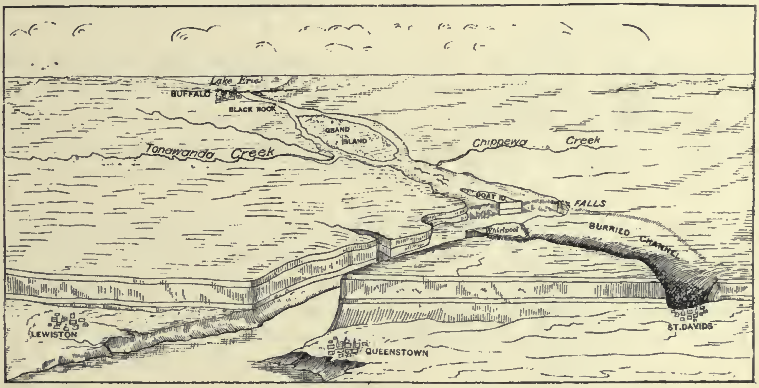

Fig. 5.—Bird's-eye View of the Niagara District (Pohlman). The buried channel or valley from the falls to the edge of the mountain at St. Davids is about a mile and a half broad, but it is not anywhere nearly as deep as the Niagara gorge.

ton (and Lewiston) and Lake Ontario. The work of the river has been to remove the soft rocks and undermine the thick and hard capping limestones. The chasm of the Niagara River is simply chiseled out of an elevated table-land, whose surface is a remarkably level plain, covered with towns, villages, and farms, extending apparently without a break until one is surprised at coming suddenly upon the brink of an abyss, without meeting with the sloping features which constitute the usual approaches to deep valleys. The feature of the gorge with unbroken perpendicular walls is shown in Figs. 6 and 7, which are characteristic forms of modern cañons. If the valley were of great antiquity it should have been two miles or more in width, in place of a gorge of a quarter of a mile wide, and it should have had scarcely any fragments of perpendicular walls standing. Indeed, an old valley, buried beneath some ninety feet of drift, does cross the course

of the modern river in the region of the falls themselves, but this is a mile and a half wide. Its section is shown beneath the drift in Fig. 8.

Indeed, there was no ancient outlet of the Erie basin in the vicinity of Niagara River, but the ancient drainage course was

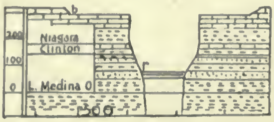

Fig. 6.—Section across the Narrows just North of the Railway Bridges (*dd*, Fig. 9). *b*, Original bank of the river; *r*, surface of the river; L O, level of lake; floor of cañon eighty feet below lake level.

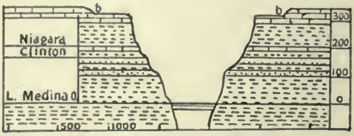

Fig. 7.—Section Half a Mile from the End of the Cañon (*gg*, Fig. 9). *bb*, Terraces of river at the original level; L O, level of Lake Ontario; bottom of river about eighty feet below the surface of Lake Ontario.

discovered about fifteen years ago to have been some forty miles farther west, where is now the buried channel of the ancient Erigan River, terminating in the extreme western end of Lake Ontario. Thus the necessity of a preglacial Niagara River was removed.

To describe the features of the Niagara River more accurately, so as to interest special readers, it may be added that from Lake Erie to the rapids above the falls the river is from half a mile to more than a mile wide, and flowing at the surface of the country with banks only a few feet high. The gorge is thirty-six thousand five hundred feet long and varies from nine hundred feet to fourteen hundred feet wide at the top. and it is three hundred and forty feet deep near the outlet. The width of the river itself at the narrows is only three hundred feet and four hundred at outlet of whirlpool, although elsewhere much broader. The rubbish in the chasm forms loose heaps of broken rock, which is constantly falling from the sides, and building up sloping banks along the water's edge, where the rains and river are constantly washing them away, and thus the cañon is slowly being widened into a common form of an old valley. The river, both near the foot of the falls and seven miles below, at the outlet of the gorge, is nearly one hundred feet in depth, descends fifty feet by the rapids above the falls, which leaps one hundred and fifty-eight feet into the abyss, from which it further descends another hundred and ten feet by the rapids below the falls. These features are

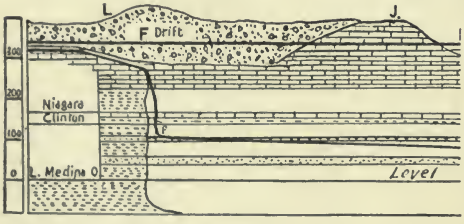

Fig. 8.—Section at the Site of the Falls, showing the Transverse buried Tonawanda Valley, F, cut out of limestones for breadth of a mile and a half and depth of ninety feet; rectangular shading represents the Niagara limestones; L O, level of Lake Ontario; F, foot of falls.

shown on the map of the gorge (Fig. 9), and in the longitudinal section in Fig. 16.

THE WHIRLPOOL AND ITS RAVINE.—The elbow of the Niagara gorge at the whirlpool has given rise to much speculation and has led to great confusion. Fifty years ago Sir Charles Lyell supposed that it indicated an ancient course of the river itself, which extended thence to the St. Davids' Valley, about four or five miles distant, although the country forms a level floor which told of no buried channel (see Fig. 5). This mistake arose from the perpendicular walls of the whirlpool basin, without the necessity of sloping sides for ancient valleys being then perfectly known, and without the author evidently going through the ravine where rocks were exposed. The serious feature of the mistake was that it led to the supposition that perhaps much of the gorge above the whirlpool was older than that portion below, and, becoming filled with drift, the river had only the drift filling to remove in modern times. This idea

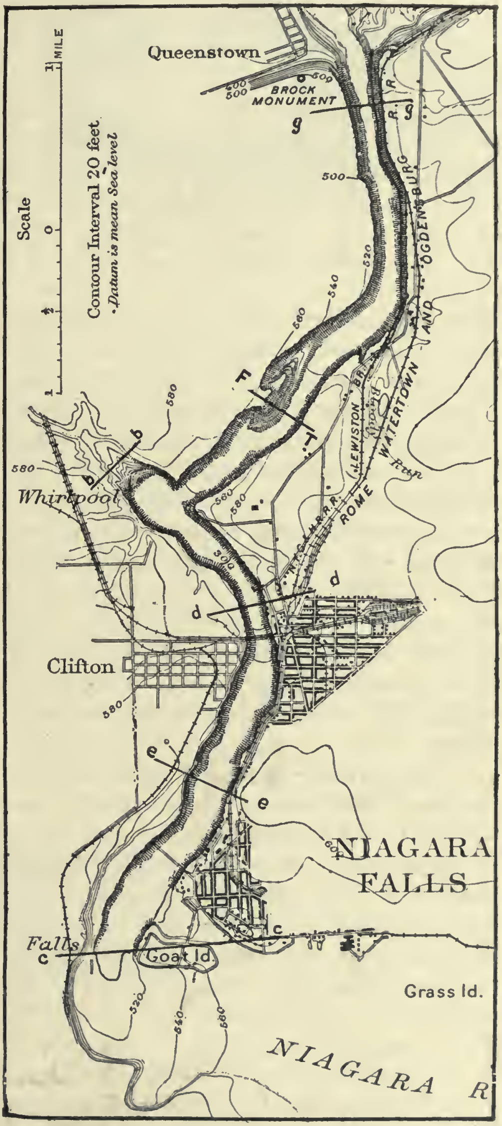

FIG. 9.—MAP OF THE NIAGARA GORGE (United States Lake Survey), SHOWING ITS VARIABLE WIDTH AND CROSS-SECTIONS.

caused Dr. Pohlman to reduce the age of the falls to three thousand years. But almost universally the error of a deep preglacial

gorge was followed, as most authors absorb the work of others without verifying it throughout. In this matter even the present writer, in the beginning of these investigations (1881), partially accepted Lyell's idea, but distinctly showed that the buried ravine from the whirlpool was not preglacial but probably that of a small interglacial stream, and not that of the Niagara River. Prof. Claypole found rocks in the ravine, and then the writer immediately corrected his statements (1887), and later explained the whole history; but apparently Prof. Gilbert had forgotten these observations and went back to Lyell's views in their entirety. The mistake was easily corrected by going through the ravine, where rocks three hundred feet above the bottom of the river are exposed, as shown in Figs. 10 and 11. The exposed rocks along the western side of the ravine show the slope as in section, which is a characteristic form of ancient valleys in contrast to the vertical walls of the cañon (Figs. 6 and 7), while on the eastern side the rocks are covered with drift and landslides, but at the same time demanding sloping walls beneath. Thus the presence of rocks so high in the ravine removes from the calculations of the work of the river the obstructions of early observers, and relegates the hamlet of St. Davids, made famous the world over, to its peaceful repose.

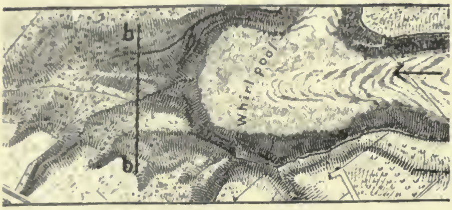

Fig. 10.—Map of the Whirlpool Ravine. *bb*, Position of section (Fig. 11).

It is perhaps necessary to explain the form of the whirlpool basin. A moderately shallow valley, now buried, was formed in ancient times by a stream flowing from near the railway bridges, and extending down by way of the buried ravine (which has given so much trouble) to join the ancient Tonawanda River a little to the west (see Fig. 5). Most of the capping limestones in the ancient little ravine near the site of the whirlpool had been removed, leaving at or near the surface only soft, shaly rocks, yet three hundred feet above the bottom of the river. When the modern falls had receded so as to reach the edge of the little buried valley, it found the surface occupied by loose materials which for a short distance the river easily swept out, and thus by the cir-

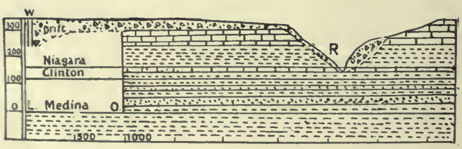

Fig. 11.—Section across the Whirlpool Ravine: located at *bb* (Fig. 10).

culating currents was the form of the basin started, and afterward deepened in the soft shales. The rocks at the end of the basin are always obscured by the landslides of the overlying drift materials.

Niagara Falls crossing the Ancient and Buried Tonawanda River.—Reference has been made to the ancient buried valley westward of the Niagara. In olden days the rains, rills, and rivulets were everywhere acting upon the surface of the land and producing broad, flattened features which are characteristic of old topography. Through such a valley flowed the ancient Tonawanda River (partially recognized by Dr. J. Pohlman), draining the Niagara district (as indicated in Fig. 5). This valley in the vicinity of the falls was about a mile and a half wide and ninety feet lower than the rocky rim which bordered the northern side (see Fig. 8), which barrier is now exposed between the railway and the carriage bridges over the river. In wells this ancient valley has been found to extend in the direction of the St. Davids Valley (Fig. 5), which is comparable in size to it, in place of turning off at right angles, as does the modern river at the location of the falls. This ancient Tonawanda River never drained the Erie basin, and when it afterward became filled with drift it did not determine the character of the modern river, except to give rise to the magnificent rapids above the falls (as shown in Fig. 17).

Effects of the Depressions of the Ancient Surface and the Geological Structure upon the Recession of the Falls.—The partial scooping out of the superficial limestones in the vicinity of the falls and at the whirlpool is the only important feature which has noticeably affected the excavation of the modern river channel, and this only to a very small extent, for the ancient depressions were filled with the rubbish of the drift period, which loose material was protected from being carried away by the flowing currents; and even after the last barrier of rock had been removed by the retreat of the falls, the river had nearly as much work as ever to do, for the recession of the falls is by the undermining of the capping limestones, and not on account of their being worn away by the river to an appreciable extent. Furthermore, the regularity of the recession has been largely maintained by the remarkably uniform character of the beds of rocks, which for a considerable portion of the length of the cañon are almost horizontal, and only at the lower end do they dip as much as fifteen or twenty feet in a mile. Now all these explanations mean that the character of the country and the geological formations would not cause any great variation in the rate of the recession of the falls, but those changes were due to the other and farther reaching causes.

Modern Recession of the Falls.—The modern rate of retreat of the cataract during forty-eight years has been determined by comparing the crest of the falls, carefully mapped by four surveys—the first by Prof. James Hall in 1842 and the last by Mr.

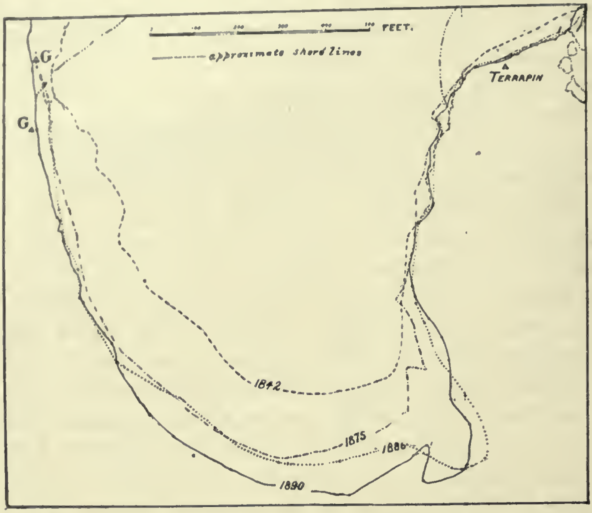

Fig. 12.—The Four Surveys of the Canadian Falls, showing the Retreat of the Cataract, in which some Inaccuracies are Apparent. (Kibbe.)

Augustus S. Kibbe in 1890. Between the times of these surveys not merely the historic Table Rock, but six acres of rocks forming the floor of the river fell away by the undermining action of the falls, and the center of the cataract moved upward for a distance of two hundred and twenty feet. From the 275,400 square feet thus removed it is found that the mean annual recession has been four feet and a sixth a year for the Canadian falls and two thirds of a foot for the American cataract. The recession is shown in Fig. 12.

The work of the falls is not uniform, for there are years of rapid central recession and slow lateral expansion, followed by even a total central rest and rapid lateral enlargement of the curve. From an approximate estimate of the variation in the amount of work due to the physical and geological structure of the district, the mean rate of recession of the falls under existing volume of water and descent of the river may perhaps be reduced to 3·75 feet a year, which factor alone would indicate the age of the cataract to be ten thousand years. But this simple story would leave out of consideration the variability of the volume of Niagara River and the descent of the cascades.

The Story of the Lakes and the Birth of Niagara Falls.—At the close of the ice age, and after the geological

broom had swept the accumulated dirt of ages from the northern country and filled up the great valleys, the lake region was covered with water; whether arms of the sea, as is probable, or as lakes, of which the barriers are not indicated, is immaterial in the history of the river, for under either condition the old shores were produced, and these we have surveyed. From them we learn the story that all the lakes formed one broad sheet named the Warren water. From time to time its surface was lowered, and at each pause new stands were formed, only to be abandoned by further sinking of the water. At last the aboriginal Warren water subsided so that it became divided in two smaller sheets—the Algonquin gulf, occupying more or less of the basins of Lakes Huron, Michigan, and Superior, and the Lundy gulf, extending over much of the Erie and the Ontario basins. With the continued lowering of the gulf, or, more correctly, the rising of the land, for no evidence of lake barriers has been found, the Lundy gulf became dismembered, forming Lake Erie, then much smaller than now, and the Iroquois gulf occupying the Ontario basin, the deserted shores of which have now an elevation much above the

Fig. 13.—View of the American Falls.

present altitude of the lake. Then Niagara Falls had their birth, and the river descended only a little more than half as great a height as to-day into the gulf (Fig. 16) which came to the mouth of the gorge. The lowering continued until the descent of the river was much greater than at present, and the shores of the lake receded not merely eight miles to the present margin of the

lake, but four miles farther. Again, the waters of Ontario were raised and the descent of the river was reduced to the present amount. Thus it is apparent that at the birth of Niagara Falls the cataract was much smaller than now, and very much resembled the size of the American Falls as shown in Fig. 13.

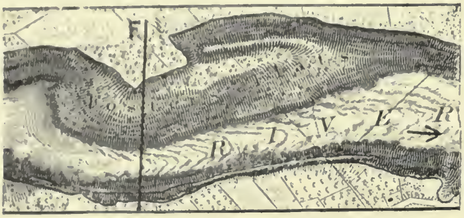

FIG. 14.—MAP OF THE GORGE AT FOSTER'S FLATS. F, Location of the cross-section (Fig. 15).

With the discovery of the history as here set forth, we had to wait several years before any clew was obtained as to how far the falls receded during each of the episodes. But at last the inquiry was partially successful; for at Foster's Flats (Fig. 14, see also Fig. 9), about two miles and a half above the mouth of the gorge, the remains of an old terrace occur (Fig. 15) at the height which shows that the falls had receded to that point before the descent of the river was greatly increased or the volume of the water enlarged to the drainage of all the upper lakes.

In this determination of the distance to which the falls had probably receded before Lake Huron drained into Lake Erie, Prof. Gilbert has followed the writer. Now, by applying the laws of the variability of erosion to the observed modern rate of recession of the falls, an approximate determination of their antiquity became possible.

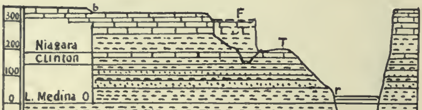

FIG. 15.—SECTION OF THE GORGE AT FOSTER'S FLATS (FT, Fig. 9). Platform (F) of the old river floor projecting into the cañon. Its section is shown in broken shading, but with ravines descending from both sides of it; T, rock terrace surmounted by huge blocks of Niagara limestones; *b*, original river terrace; *r*, surface of river; L O, surface of Lake Ontario. Bottom of river about eighty feet below the surface of the lake.

CAUSES OF FLUCTUATION IN THE VOLUME AND DESCENT OF NIAGARA RIVER.—In the survey of the deserted shores it was found that since they were formed as old water-lines they have been tilted upward toward the north and east at variable rates, from a few inches in a mile at the southwest to four or even seven feet per mile in the opposite direction. The phenomenon belongs to the consideration of the history of the lakes, but its effect was to tilt the lake basins so that the water ran over the southern rim of Lake Huron into the Niagara drainage. So, also, the tilting of the Ontario basin raised the barrier at the outlet and caused the waters to rise and flood the lower lands at the head of the lake, and shorten the Niagara River by four miles

or more, and reduce the descent of the river by eighty feet or more.

EPISODES OF THE NIAGARA RIVER AND THEIR DURATION.—At first the river flowed without falls, as shown by the old banks and terraces, for a period estimated at a thousand years. Then the waters of the lower lake began to subside, whereupon the Niagara Falls had their birth. The new cataract slowly grew in height, although characterized by temporary pauses, until the river cascaded two hundred feet from the table-land into the edge of the gulf or lake which occupied the Ontario basin, as shown in Fig. 16.

The volume of the water of Lake Erie is about one fourth that of all the upper lakes, and only this proportion of the discharge of the modern Niagara River formed the abrading agent of the falls at that early date. This general condition lasted for seventeen thousand two hundred years.* After this episode, the descent of the river was increased to four hundred and twenty feet, and the lake receded twelve miles from the foot of the mountain, and then there was a series of three cascades, the lower always gaining upon the upper on account of the softer rocks. Yet the increased amount of work to be done, even though easier than the recession

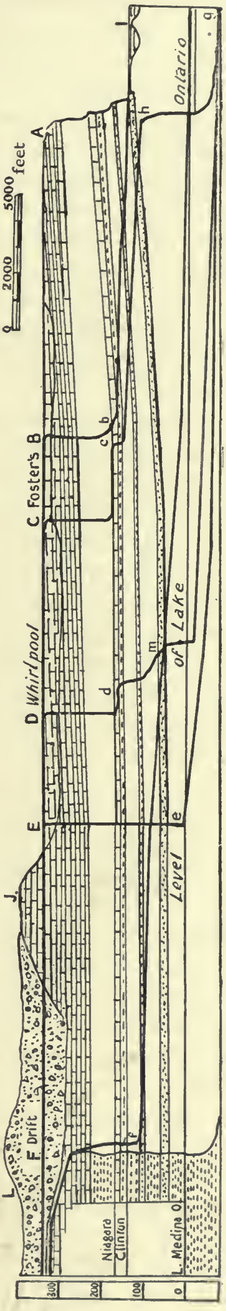

FIG. 16.—LONGITUDINAL SECTION, SHOWING THE RETREAT OF THE FALLS AND THE GEOLOGICAL STRUCTURE. A, Brow of escarpment and original site of falls; I, Iroquois beach and level of that water; B *b* I, chasm at the end of the first episode; C *c h g*, falls retreating in three cascades, but from *h* to *g* the slope was extended over a distance of twelve miles beyond the escarpment; D *d m g*, position of cataracts at the end of the second episode; E *e g*, development of gorge at the end of the third episode; F, present site of falls, and F *m g*, the modern cañon; *g*, level of the lowest stage of water in the river history; L, Lundy beach capping the drift; J, Johnson's ridge. Broken shading about whirlpool shows occurrence of drift on west bank only with rock on the eastern; block shading represents limestone; dotted, sandstone; broken lines and unshaded portion, shales. Bottom of river eighty feet below present surface of Lake Ontario, as shown in figure.

* For the methods of computation of the duration of the episodes of Niagara Falls see Duration of Niagara Falls and the History of the Great Lakes, pp. 1–126, 1895. Also see Duration of Niagara Falls, American Journal of Science, December, 1894, pp. 455–472—both works being by the writer.

of the upper cascade, prolonged the episode to six thousand years, when Foster's Flats were passed. By this time the waters of Lake Huron were probably turned into the Niagara by way of Lake Erie. With the increased magnitude of the river the falls are thought to have receded as far as the head of the whirlpool, requiring four thousand years. By the close of this stage there were some important changes in the river, as when the narrows of the whirlpool rapids were excavated, and the three cataracts of the second episode appear to have been united into one great fall. With the increased volume of water at the maximum height of the falls, as at the apex of the modern horseshoe cataract, the recession was very rapid, so that the falls receded to above the railroad bridges in eight hundred years more. It was in the next episode that the descent of the river was reduced from four hundred and twenty feet to three hundred and twenty-six feet, which is that of the present day. These changes of height of falls and volume of the river must not be supposed to have been sudden, and, although they were secular, yet there were long periods of rest, as shown by the landmarks, which are mostly obliterated where they were imperfectly engraved during short epochs of repose. The first stage of the last episode is characterized by the retreat of the falls through the great rocky barrier (Johnson's Ridge, *e e*, Fig. 9) on the northern side of the buried Tonawanda Valley. Beyond this barrier the river speedily removed some ninety feet of drift for a distance of a mile and a half to the head of the rapids above the horseshoe cataract, and the recession across the buried valley has been the last stage of the present episode of the falls. Here the necessary time for the retreat of the falls since passing the railway bridges has been three thousand years.

Adding the duration of the various stages of the river together, the age of the falls is computed at thirty-one thousand years, or of the river thirty-two thousand years. These figures are based upon the severest analytical methods at present attainable, but the discoveries in the physics of the river cover most of the doubtful points; yet in the determination of the amount of work performed in the middle episodes some points are open to revision, but the errors they cover form only a small portion of the life of the cataract, and a little time, more or less, would not greatly change the results given. No general guesses or objections have been found worthy of consideration. The determinations had to be attempted in parts, and the aggregate results have been confirmed by two other sets of investigations: one on the relative amount of tilting of the deserted shores, and the other upon the rate of the rising of the land in the Niagara district, which has been found to be about one foot and a quarter a century, but much more rapidly to the north and east.

Niagara Falls narrowly escaped Extinction.—Fifteen hundred years ago the terrestrial movements raised the Johnson barrier to the Erie basin so high that the waters of that lake reached not merely the level of Lake Michigan, but the point of turning all the water of the upper lakes into the Mississippi drainage by way of Chicago. But the falls were then cutting through the ridge, and when this was accomplished, before the change of drainage was completed, the surface of Lake Erie was suddenly lowered by many feet, and thus the falls were re-established for some time longer.

Death of the Falls.—Slowly, year by year, one sees the cataract wearing back and suggesting the time when the river will be turned into a series of rapids; but another silent cause is at work, and one not easily seen—namely, the effects of the changing of level of the earth's crust. From the computations already referred to it was found that for the first twenty-four thousand years of the life of the river only the Erie waters flowed by way of the Niagara River, and for only eight thousand years have all the waters of the upper lakes been feeding the falls. If the terrestrial movements continue as at present, and there appears no reason to doubt it, for the continent was formerly vastly higher than now, then in about five thousand years the rim of the Erie basin promises to be raised so high that all the waters of the upper lakes will flow out by way of the Chicago Canal. Thus the duration of Niagara Falls will have continued about thirty-seven thousand years. But the lakes will endure beyond the calculations of the boldest horologist.

Relation of the Falls to the Ice Age.—In telling of the times of the great mutations in the physical history of the lake region, the story of Niagara Falls seems completed, but as a timepiece they are much more important in being used as a stepping stone back to the great period of frost which separated the former order of the continent from the modern. Having ascertained the approximate amount of the rising of the land recorded in the deserted beaches, before and since the birth of Niagara Falls, and the rate of the rising of the land, and applying it to the movement recorded in the abandoned shores, it is concluded that the epoch when the lake region formed great expansions of more or less open water commenced fifty or sixty thousand years since. Going so far back in time, other conditions may have obtained to vary the rate, but these have been allowed for as far as possible.

Beyond the lake epoch the vicissitudes between the periods of great regional submergence and the earlier high continental elevation of the ice age proper are apparent, but the events are certainly unexplained, for what was done by glacial action and what by waves has not been determined. Niagara Falls

Fig. 17.—View of Rapids above the Falls and of Horseshoe Cascade; also the Sand Terrace and Ridge of Till on Canadian Side.

shows that the end of the Glacial period in the lake region was long ago.

HOW NIAGARA FALLS MAY BE USED TO ASCERTAIN THE ANTIQUITY OF MAN.—The relation of Niagara Falls to the deserted shores of the lake region and the high terraces is now pretty well known, and the old water margins have been traced over wide areas; but these may be much further extended and their relations to other regions beyond the drainage basins of the Great Lakes be ascertained, so that we may hope that Niagara Falls may be used as a means of at least roughly estimating the age of the deserted river banks on which the oldest inhabitants left their scanty treasures long ago. Concerning this application, it seems as only a question of the work of so many men and so much time.

To the geologist, the birth, life, and death of Niagara Falls show no more rapid changes than come within the limit of modern observations. There have been no sensational catastrophes, although in the popular mind these changes come with new and startling revelations, so that the most conservative observer may be surprised. The changes in the history of Niagara have now been told, so far as we know them. We can still watch the river performing its wonderful amount of work and the slow recession of the falls, as shown in Fig. 17.

If the reader of this sketch of the history of Niagara Falls desires the fuller information upon which this study is based, he is referred to Duration of Niagara Falls and the History of the Great Lakes, by the present writer, whose labors have been brought together by the Commissioners of Niagara Falls Reservation, under the presidency of the Hon. Andrew H. Green, whose liberal policy is not merely to preserve the falls as an international park, but to make known their scientific history.

IN the ascension of the balloon Phenix, made from Stassfurt, Prussia, in December, 1894, the weather being misty at starting, the temperature at first increased up to a considerable height, but afterward fell, and at 32,150 feet stood at $-20°$ C. At about 29,500 feet the balloon passed through a veil-like stratum of cirrus clouds, consisting of perfectly formed flakes of snow. At 31,500 feet the thermometer dropped to $-54°$, and indicated only $-11°$ in the sun's rays. The highest temperature recorded was 43°. During the ascent of three hours and the descent of two hours and twenty minutes the balloon traveled one hundred and eighty-six miles, although it was almost calm at the surface.

OBSERVING the growth of bamboos in the Botanical Garden of Buitenzorg, Java, Mr. Gregory Kraus noticed one plant which added to its length 22·9 centimetres a day for fifty-eight days. Another plant grew 19·9 centimetres, and a third nineteen centimetres a day for sixty days. The longest single day's growth observed was 42·45 centimetres.

THE DEVELOPMENT OF THE MONETARY PROBLEM.

By LOGAN G. McPHERSON.

THE consideration of every problem concerning the welfare of humanity compels, first, the understanding of what constitutes that welfare. That is, recognition must be had of the factors that forward civilization, which is the condition that permits the attainment by each individual of the highest harmonious, physical, mental, and moral development of which he is capable. To the highest physical life it is necessary that the body be nourished by a regular and sufficient supply of food; that it be protected by appropriate clothing and properly housed; that it receive the exercise and the care and attendance that contribute to the maintenance of the bodily functions. To attain the highest mental life it is necessary that knowledge of that which mankind has said and done shall be brought to the mind of each individual, to the extent that such knowledge will the more thoroughly adapt him to his environment and enable him to most effectively react upon that environment. In the agencies that lead to these ends—that is, in the production and distribution of food and clothing; in the erection and furnishing of houses; in the processes of manufacture that result in the various articles of personal use; in the production of newspapers, books, paintings, and statues; in the composition and rendition of music, and in all the other functions that contribute to bodily and mental welfare and gratification—are employed the efforts of by far the greater number of the adult male population and of a considerable number of the female population of the civilized world. As this effort is so interwoven that it is almost if not quite literally true that the work of all contributes to the welfare of each, and the work of each contributes to the welfare of all, it is manifest that there must be some means whereby the portion of welfare accruing to each individual from the totality of effort may be measured out to him, and as human effort has become the more closely interwoven has this means changed in becoming the more adapted to its purpose.

In prehistoric time, the man whose home was a cave, whose clothing was the untanned skins of beasts, and whose food their flesh and berries and fruit, knew not money and needed not money—the satisfaction of his wants resulted immediately and directly from his own exertion. And so likewise throughout the untold years during which he learned to cook with fire made by the spark of flint and to fashion the flint into spear heads, he needed not of the effort of others. But through the ages, as his developing brain led his hands to other uses, as he learned to

mold and harden the clay into pots, to fashion and wield the oar, to weave the bands of willow into mat and basket, it became impossible for any one man to accomplish for himself all that man had learned to do. There was division of labor, first perhaps between a man and the women of his household, but in time the efforts of the members of any one family alone became impossible to supply its wants. There was a further division of labor, and the exchange of the results of effort is the more marked as the division of labor increases. When one man traded pots of clay to another for flesh obtained in the chase, the efforts of the one in digging, molding, and baking were exchanged for the efforts of the other in hunting, killing, and delivering the game. This was barter and barter, or the exchange of effort as embodied in desired commodities, without the intervention of other commodities, endured over much of the earth for centuries, complicated by the customs of slavery, feudalism, and absolutism. But as man learned in a greater number of ways to produce a greater variety of articles, barter became inadequate to effect their exchange. A weaver might want a bow and a dozen arrows, and a maker of bows and arrows might want a bolt of cloth; but the weaver, perceiving that he had to work six days to make the cloth, while six bows and as many dozen arrows might be made in that time, of material no more difficult to obtain and by a man no more skillful than himself, would properly refuse to exchange the cloth for fewer than that number of bows and arrows—that is, a bolt of cloth would be worth six bows and six dozen arrows. If, however, the exchange were so made, the weaver would have five bows and five dozen arrows which he did not need. He, therefore, would not obtain the reward for his own use of his effort in producing the bolt of cloth until he had exchanged the five bows and five dozen arrows for articles that he could use. Consequently, if barter were persisted in, each purchaser would accumulate a number of articles of different kinds for which he had no need, and he might have no place wherein to store them. Each producer would be endeavoring to exchange articles made by every other producer, and so have his time absorbed that his efforts in production would be lessened. The process of exchange would be of inextricable confusion. If, however, there were some one commodity for which each producer would readily exchange his products at any time, so that, therefore, each person could at any time exchange this commodity for any other commodity that he might need, the process of exchange would be simplified. It is evident that such a commodity must occupy little space, so that it could be readily stored, that it must not be perishable, and that it must be so divisible that different portions of it might be exchanged for different commodities in proportion to their value—that is, in

proportion to such quantity of the commodity as might be accepted by the seller for and yielded by the buyer to obtain the article exchanged. Such a commodity used for the convenience of exchange is money; and all peoples who at different places on the earth's surface at different times have step by step risen from barbarism through barter have made use of money. Different commodities at different places and with different peoples have served for this purpose—skins with one tribe, shells with another, beads with another, and even in our own country, within the last two hundred years, the leaves of the tobacco plant. But no other substances known to man have so completely possessed the attributes of permanence of form, durability, and divisibility as the metals; and therefore lead, tin, copper, silver, and gold have been very extensively used as money.

Another characteristic essential for a commodity used as money is its acceptability, not only among the persons of a particular locality, whose efforts are interchanged, but among the people of all localities whose efforts are interchanged. The shells accepted by the members of one tribe might not be acceptable as money by the members of another tribe among whom skins were used for that purpose. If the members of the tribe using shells as money wove mats and molded pots, which were acceptable for exchange for tools made by the tribe using skins as money, and the money of neither tribe were acceptable to members of the other, there would be direct barter of the tools of one tribe for the mats and pots of the other. But as barter between individuals of one locality results in confusion, so also does barter between individuals of different localities, and the confusion in the processes of exchange by barter becomes the more inextricable as an increasing number of people in an increasing number of localities produce an increasing number of articles acceptable for exchange among the different peoples of the different localities. With the extension of intercourse between tribe and tribe, race and race, has therefore increased the tendency toward the use as money of commodities acceptable as money over the more extended territory occupied by the peoples whose efforts were interchanged. With the increase of this tendency the use of metals as money increased. They have been found in nearly all parts of the earth, and because of their general acceptability—that is, because of a certain common estimation in which they have been held—they have attained to a degree uniformity of value, which has the more nearly approximated perfect uniformity of value as the use of metals as money has become restricted to the metals meeting in greatest degree the requirements of money, which are silver and gold. And as the common needs of similarly situated groups of people have resulted in the formation of the more or

less coherent bodies known as states and nations, the use of gold and silver as money has the more extensively been sustained by coinage—that is, the weight and fineness, and therefore to a degree the value, of different portions of these metals have been evidenced by the stamp of the administrative bodies of states and nations, and this use of gold and silver has been enhanced by their exquisite luster.

As commodities were exchanged in larger volume, metals of the greatest value were coined. The extensions of intercourse between races incident to the conquests of Philip and Alexander were marked by the coinage of gold. At the time of the decemvirs, the Romans passed from barter to the use of copper coins; as their commerce increased, the southern settlements along the sea made use of silver, and, finally, after gold bullion had long been the medium of exchange in Eastern commerce, Julius Cæsar opened the mints to gold. After the submersion of the Roman Empire the coinage of gold was not resumed until the florin was issued at Florence in 1252—the extensive commerce initiated by the Crusades demanding a more valuable medium than silver.

The different weights, sizes, and shapes of coins made by different nations, the different units of value by which they have been measured, and the different languages in which their values have been expressed, have caused much confusion, as different tribes, races, and nations have passed beyond restricted intercourse between their own members to commercial intercourse one with the other, or rather, as individuals of particular tribes, races, and nations have undertaken commercial intercourse with individuals of other tribes, races, and nations. Hence the money-changers of antiquity, the remote forerunners of bankers who arrange international exchanges to-day. With the combination and recombination of tribes and races under governments, whose administration has extended over considerable areas, the monetary systems have become correspondingly fewer—the imperial coinage of the German Empire supplanted seventy different coinage systems of the combined states—and coins of the different nations have the more nearly approached uniformity in shape, weight, size, and value.

But even the precious metals, although they satisfy the requirements for money better than any other commodities, do not meet those requirements in perfection.

In the first place, the amount of silver and gold in existence at any one time is never in the same proportion to the volume and value of the exchanges of that time as it is to the volume and value of exchanges at other times—that is, the volume of gold and silver does not expand and contract in exact accord with the expansion and contraction of commerce. Nor is it conceivable that

the rapidity of circulation of either gold or silver varies in exact ratio with the variations of trade. The growth of commerce, for example, that began in Europe during the thirteenth century, so far outstripped the increase in the supply of the precious metals that each of the petty states and principalities was in a continual fight with the others for the possession of a sufficient supply of gold and silver whereby the exchange of effort as evidenced by the exchange of commodities between its own subjects could be rewarded. The world's product of gold was nearly four times as great in 1850–'60 as during the preceding decade; it was about twenty-five per cent less in 1880–'90, and during the present decade promises to exceed that of 1880–'90 by one hundred per cent.

And the supply of neither metal increases in the same ratio as the other; therefore, that pursuit after a constant ratio between gold and silver which has continued to this day is vain as the cruise of the Flying Dutchman.

And as it is estimated that at the present time actual coin passes in less than ten per cent of the exchanges, it is significant that a medium of exchange has largely taken the place of coins. This medium consists of paper representatives of value.

And, again, the quantity even of gold necessary to effect any considerable exchange is of such weight that its transportation is a matter of inconvenience, and for any person or association of persons to keep safely on hand all the gold that might be amassed at any one time would necessitate expensive precaution. Obviously these inconveniences are avoided by the deposit of silver or gold coin or bullion in the charge of a person or persons responsible for its safe keeping, and for its transfer from the owner to another as he may direct. Hence banks of deposit and payment by check, the use as money of paper representatives of money. For if B is willing to accept the check of A upon banker C in the belief that he can obtain the money for which it calls upon presentation, why should not D accept the same check from B upon B's assurance that it is good?

If A, buying merchandise from B, says that he will have the money wherewith to pay for it when he has resold the merchandise, or at the end of a particular time, B may be willing to accept his written promise to pay; usually, however, with the stipulation that A surrender an additional sum as compensation to B for waiting for the payment. This sum is interest. And upon B's guarantee that the promise is good, D may be willing to accept the promise from B as payment for other merchandise. Or if B need the money in advance of the time specified in A's promise to pay, he may perhaps deliver the promise to D in return for the money. Or, as would be more likely, he would seek

to obtain the money from banker C in exchange for the promise of A guaranteed by himself. It is obvious that should D or banker C pay to B the full amount of money specified in the promise of A, he would be dispossessed thereof from the time it was given to B until it was repaid by B—that is, he would have rendered a service without compensation. It is equally obvious that compensation would be obtained if a portion of the sum specified in the promise were withheld by C. This sum is the discount. Banker C, by making a practice of thus advancing money on such promises, may obtain a considerable revenue. Hence banks of discount.

There are banks which not only make money by discounting from the amount of deposits over and above what they estimate will be required for daily needs, but which issue promises to pay in the form of bank notes, the funds available for use in discounting being, therefore, increased. Hence banks of circulation.

The development of banks, therefore, has been from simple repositories of the commodity used as a medium of exchange into purveyors of the currency that is superseding coin, the providers of funds for commercial transactions, and the centers through which instruments of exchange are balanced.

Besides the checks and promissory notes issued by individuals, which have a limited circulation, and the notes issued by banks, which have a more extended circulation, many governments issue notes directly that circulate generally among their peoples. As, however, the precious metals are the only commodities generally accepted as money throughout the world, all promises to pay are based upon one or another of them, but the aggregate of value represented by these promises to pay is so great that their fulfillment at any one time in coin or bullion would be impossible, the ratio between the volume of exchanges effected by the use of paper representatives of money to the volume effected by coin or bullion itself being, as has been said, greater than nine to one.

This fact, that the total value called for by the paper representatives of value at any time in existence, although expressed in terms of the units of value originally designating coins, vastly exceeds the value of the metals as coined or held in bullion by the sources whence coins are issued, together with the fact that no man willingly and knowingly exchanges commodities for paper representatives of value without believing that he can obtain the worth called for by these representatives, leads to the perception that, after all, it is not the metals, however precious, but property of all kinds that is their basis, and that these paper representatives of value are succeeding coins in designating and

measuring the value of the commodities for which they are exchanged. And as the value of commodities depends upon the efforts expended, under the law of supply and demand, in producing and delivering them at the place of need, the ultimate function of paper representatives of value is to measure and reward human effort.

By way of example, let it be supposed that a tailor sells a suit of clothes and receives in payment therefor a check for, say, fifty dollars. He deposits that check in a bank in the belief that he can obtain a definite worth for it in whatever commodities or services he may choose to invest it, and the bank likewise accepts and places it to his credit, in the belief in the ability of the signer and indorser to produce commodities or services of the value for which it calls. If the tailor buys a set of furniture and gives his check for fifty dollars therefor, what he has done has been to exchange the value of cloth as measured, cut, sewed, and trimmed into particular shape for timber, cut, joined, and varnished into a particular shape of what he deems an equal value. The value of the efforts of men expended in producing the clothes has been balanced against the value of the efforts of men expended in producing the furniture. If fifty dollars in coin were received for the clothes and given for the furniture, the effort expended in producing the clothes would be measured against the effort expended in producing the furniture, by the use of an intermediate commodity; if a check were received for the clothes and a check paid for the furniture, effort would be measured against effort by means of paper representatives of value through the agency of a bank. If the tailor, instead of purchasing furniture worth fifty dollars, purchases a number of articles aggregating fifty dollars in value, the result is the same. The efforts of men in producing the number of articles have been measured against the efforts of men in producing the suit of clothes, and this is the function performed by money in every exchange, whether great or small, and whether the money is coin or a paper representative of value. Effort as expressed by result is measured against other effort as expressed by other result.

The test of the efficiency of a paper representative of value, therefore, is the extent to which it can be exchanged for the value which it expresses. But as the value of a paper representative of value is expressed in terms that also express the value of coins, it is a measure of so much value as is represented by the coins, and a paper representative of value is at present almost universally considered as such only to the extent that it is the representative of coin. A certain amount of coin, or the bullion from which it is derived, has a definite and known value

as coin or bullion, without qualification or condition, throughout civilization, but a piece of paper representing the value of that amount of coin or bullion considered simply as paper, whether covered by writing or impressed by an engraved block, is without intrinsic value. That is, for example, twenty-nine grammes, 448·025 grains, of fine gold, whether in bullion or coined into a hundred-franc piece, can readily be exchanged throughout Europe and almost as readily throughout America for an approximately similar amount of commodities; but a piece of paper known as a National Bank of Belgium one-hundred-franc note can be exchanged for commodities to this value only among peoples who feel confident that it can readily be exchanged again in return for commodities to the value of one hundred francs, and such peoples in great numbers do not exist outside the kingdom of Belgium, because other than the Belgian people are not generally familiar with the language in which the note is printed, and therefore do not understand the value of the units of value in which the note is expressed, and they are not sufficiently familiar with the Belgian banking system to know that the note is secure—that is, that twenty-nine grammes, 448·025 grains, of fine gold, can readily be obtained for it. The extent to which a paper representative of valuo, which in itself has no intrinsic value as a commodity, will circulate is therefore at present determined by the number of people who believe that it can readily be exchanged for coin or bullion to the value expressed by it. Essential to this belief are confidence in the honesty and ability of the issuer. Therefore, when a people among whom paper representatives of money of a particular issue have been freely circulating begin to lose confidence in their ability to readily exchange them for the coin for which they call, there arises a tendency to exchange commodities and services only for coin. As this tendency increases, as the lack of confidence in the paper grows, there is soon reached a time when the exchange of commodities and services is greatly diminished, because there is only sufficient coin in existence to effect a small fraction of the normal value of exchanges.

But, as measures of value in the last analysis are measures of human effort as determined by its results, it is obvious that, were every paper representative of value so secured that the holder thereof might be certain that at any time he could obtain in exchange for it the result of human effort to the measure of the value called for by it, in a form acceptable to him, such paper representatives of value would obtain free and general circulation among all people believing in their security. The more extended the territory throughout which, and the greater the number of people among whom, such a currency would circulate, the less

would be the need over such territory for the use of bullion or coin as money or the basis of paper representatives of value. And the monetary systems of the peoples among whom commerce has obtained the greatest development are gradually reaching such a basis. The paper representatives of value, which at first were direct representatives of coin, are tending more and more to become the representatives of value, as expressed by the result of effort, without the intervention of coin, and in the furtherance of this tendency banks perform an essential part. In the evolution of the social organism banks become the ganglia through which the action of the different parts of the organism is measured and made reciprocal.

And as the use of bank notes, checks, bills of exchange, government notes, and other paper representatives of value is most marked among the peoples through whose exertions commerce has attained its highest development, so also the members of a highly civilized community most concerned in commerce make greater use of these paper representatives of value than other members of such a community. In any large city the transactions of the principal manufacturers and merchants are chiefly conducted by means of checks, bills, and notes, while clerks, artisans, and laborers, who are principally paid in coin or the direct representatives of coin, secure needed commodities by the immediate exchange of coin or the direct representatives of coin for them. The development of representatives of value not based upon coin to the extent of rendering them generally acceptable for exchange among clerks, artisans, and laborers would still further decrease the dependence upon coin or bullion as money or the basis of money, leaving coin and bullion freer for use in effecting exchanges between peoples of different nationalities who are so separated by language, habits, or institutions that commercial intercourse between them must be upon a bullion basis.

One of the incidents of the recent deep-sea dredging expedition of the Prince of Monaco most fruitful in scientific results was the capture of a sperm whale. It occurring to the prince that the food collections in the animal's stomach might include specimens of creatures still unknown, the ship was held near the whale till it died. In its convulsions it threw up a mass of fragments of very curious cephalopods, which were beginning to float away and be scattered and lost to science, when the ship's screw was reversed to create a counter current, under the advantage of which specimens of two entirely new species, quite different from any hitherto known, were recovered. The body of one was covered with scales, and was more than ninety centimetres long. The other had a crown of tentacles armed with suckers bearing claws like those of the larger birds of prey.

PRINCIPLES OF TAXATION.

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II.—THE PLACE OF TAXATION IN LITERATURE AND HISTORY. PART IV.

TAXATION IN FRANCE.—No chapter in history is more replete with interest and instruction than that which exhibits the system for exacting contributions for the support of the state which characterized the fiscal policy and administration of France during the seventeenth and eighteenth centuries, and which is now acknowledged to have been mainly instrumental in bringing on the memorable revolution in the closing years of the latter century.

Feudalism in France, previous to 1789, had come to find its expression almost exclusively, in the claims on the part of the various and multiplied representatives of authority—nobility and clergy—to regulate taxation, in respect to both imposition and exemption.

The kingdom was divided into departments, with an officer called an "intendant," or "farmer-general" (*fermier général*) at the head of each, into whose hands the whole power of the crown in respect to revenue matters was delegated. Each department was then sub-divided, and at the head of each of these subdivisions a deputy was appointed by the intendant. The rolls or lists of the various crown taxes, for polls, service, incomes, "proportions," and the like, were distributed by the intendants to their deputies, who had the power to exempt, change, add to, or diminish the list at their pleasure.

It must be obvious, that the friends of the intendant and of all his deputies, and the friends of their friends, might be favored at the expense of the helpless masses; and that great noblemen in favor at the court, to whom the intendant himself would naturally look for protection, would especially find little difficulty in transferring most or all of the burden of tribute rightfully due from them to the state, to others who had no such influence. The result was that taxation in France at the period mentioned had become in the highest degree arbitrary, and a scarcely disguised form of plunder; and the methods of assessment were so crude and defective that it is probable that the state never received fifty per cent of the amount collected, and in many cases no more than forty or thirty per cent. The expenditures of the revenues received were, moreover, characterized by so little system as to render it difficult to exercise any efficient check

upon them, or to ascertain accurately at any one time (as was especially the case during the latter third of the eighteenth century) the true state of the national exchequer; all of which fostered indefensible waste and extravagance. At the death of Louis XV in 1774, the annual expenditure of the king and his household probably amounted to one eighth of the entire revenue of the state,* and the total indebtedness of the state in 1789, the year of the commencement of the revolution, was estimated as being in excess of $1,000,000,000, carrying an annual interest of $206,000,000; and it is to be remembered that these figures must be at least doubled to represent the corresponding sums of the present day. All this indebtedness, and all that was subsequently incurred through the issue of irredeemable "assignats" (paper or fiat money), was ultimately, through one means or another, entirely repudiated.

In the collection of levies the inquisitorial, infinitesimal assessment and dooming penalty system, the like of which still finds favor in Massachusetts, was carried out to perfection; and the only rule of practice which in different districts could prefer any claim to uniformity, was the rule of inequality of assessment, and harshness and cruelty in collection. Arthur Young, an English gentleman of culture and keen powers of observation, who traveled in France in 1787–'89, states, in recording the above experiences, that "he shuddered at the oppression of which he became cognizant."

One of the chief sources of revenue to the state was from an exaction known as the *taille*,† which was mainly in the nature of a direct tax on land, though in some provinces it was a levy on both polls and land. The history of this exaction has been carefully investigated and is not a little interesting. It originated in the early feudal period, and was imposed on persons originally bondsmen, or on persons who held in "*farm*," or *lease*, or resided on the lands of a noble or suzerain, and from which the proprietors or suzerains of the land were exempt. And as no vassal could at will divest himself of servitude or allegiance to his lord or suzerain, so the obligation to pay tribute (taxes ?) always remained upon him as a personal servitude, wherever he might be In other words, the condition of the masses in France during the middle ages was not unlike the condition of the slaves in the United States previous to emancipation. These had property in

* There were seventy-five officers connected with the king's chapel alone; forty-eight physicians, surgeons, and apothecaries attached to his person; and three hundred and eighty-three men and one hundred and thirty-three boys employed for his table.

† The *taille* was the equivalent of the English "tallage." But the discretionary power of levying the impost was taken away from the English crown and nobility by the provisions of Magna Charta.

their possession, and spoke of themselves as owners of property, but in reality their property followed the condition of the servitude of their persons, and both persons and property belonged equally to the masters. The *taille,* furthermore, as a badge of servitude, was supposed to dishonor whoever was subject to it, and degrade him not only below the rank of a gentleman, but of that of a "burgher," or inhabitant of a borough or town; "and no gentleman, or even any burgher," writes Adam Smith in 1775, "will submit to this degradation."

(Repulsive and barbarous as was the *taille,* it is curious to note that the principle involved in it still survives and finds recognition and practice in States claiming a high civilization; as, for example, in Massachusetts and Connecticut, where personal property is held to owe a servitude to the State and to be subject to taxation by it in virtue of the citizenship or personal domicile of its owner, although the property itself may be located beyond the territory and jurisdiction of the taxing power.)

The hardship and injustice of the practical working of the *taille* may be thus illustrated: In all cases the nobility and the clergy were exempt from its payment, as were also the holders of a multitude of minor Government offices, which, however, did not carry with them any patent of nobility. These exempt classes, which in the time of Louis XVI are believed to have numbered some 300,000 out of a total estimated population of 25,000,000 in the kingdom, owned about one half of the whole soil of France; so that the burden of the *taille,* amounting in 1789 to 110,000,000 livres (francs), fell exclusively on the rural classes; especially upon the agricultural interests, which it would have been sound policy on the part of the State to favor.

"But the mode in which the *taille* was levied still further illustrates its iniquity. The Comptroller-General of the Finances, in the first instance, decreed that a certain aggregate sum was to be raised, and then two subordinate officials and the local landlords in each province and parish were left to decide among themselves how the prescribed amount was to be exacted from the taxpayers. The combined forces of jobbery and absolute authority rendered its incidence grossly unfair, the poorer localities generally paying the larger share, while the richer ones escaped lightly. Thus there was brought about a condition of things in which the most miserable sections of the community were made to feel their inferiority in every relation of life. They were humbled in all their feelings, and they could not but loathe those whom birth or favoritism had placed above them." *

Besides the *taille,* two other forms of direct exaction were in-

* The Financial Causes of the French Revolution. By Ferdinand Rothschild.

cluded in the fiscal policy of France at the period under consideration—namely, a so-called capitation tax, which was a kind of graduated tax on capital, and from the incidence of which there was theoretically no exemption; and the *vingtième* (one twentieth), instituted by Colbert, which was an income tax, and supposed to be levied on every class. Owing, however, to inefficient administration, and to the circumstance that the clergy occasionally bought exemption for themselves for a term of years by the payment of a lump sum, the revenue derived from these sources was always much less than it ought to have been, the privileged class to a large extent evading assessments.

The almost complete exemption of the clergy of France during the ante-revolutionary period from taxation, whereby those who were supposed to preach and practice charity were so intent upon securing worldly vantage as to have thrown nearly all their duties and responsibilities to the state upon the poor, constitutes one of those striking contradictions which so often confront us in history.

The indirect taxes were very numerous; comprising the customs, the octroi, the excise, and special taxes on wines, cards, tobacco, salt, and on a great variety of manufactured products; and in their collection the arbitrary, inquisitorial, infinitesimal, and penalty system was carried out to perfection. It was this class of taxes which undoubtedly pressed most heavily on the French poor, and from the direct incidence of which the Church and nobility managed in a great degree to escape. Very curiously, also, they constituted an inducement to the peasantry to seem poorer than perhaps they actually were, and to live in low, thatched cottages, without floors or glass in the windows, inasmuch as any improvement of their dwellings meant an increase of their taxes. Custom duties were levied, not only at frontiers of the kingdom, but between every province of France. The *taille* was exacted with military severity. "Carriages and carts were stopped on the highway and searched by the tax collectors; no private house was safe from them by day or by night; and on the slightest suspicion they used the power of arrest that was vested in them. Prosecutions for unpaid taxes were carried on with the utmost rigor. The clothes of the poor were seized, and even their last measure of flour, and the latches on their doors. Collectors, accompanied by locksmiths, forced open doors and carried away and sold furniture for one quarter of its value, the expenses exceeding the amount of the tax."—*Taine.*

The most vexatious, arbitrary, and extraordinary tax of this period was that imposed on salt, and known as the "*gabelle*"; and to one who now acquaints himself with its history and details it must seem almost inconceivable that any country claiming to

be civilized ever could have had such an experience. In order to effectually secure at the outset the payment of this tax, the right to produce and sell salt was vested exclusively in the state. By an ordinance in 1780, every person over seven years of age was required to purchase, not at convenience, but on one stated day of each year, seven pounds of salt, which in a peasant's family of four, according to Taine, entailed an expense equal to the average wage receipts of nineteen days' work. It was forbidden also to divert a single ounce of the seven obligatory pounds to any use but the "pot and the salt cellar." If any one failed in these observances he was fined; and he was also fined if he purchased a smaller quantity than the law prescribed. To supplement the use of salt with water from the ocean, or from saline springs, or to water cattle in marshes or other places containing salt, was forbidden under severe penalties. In certain departments of France it was also made incumbent on officials periodically to destroy, often by defilement, all deposits of salt which were formed naturally. No retail dealing in salt was permitted, but Government warehouses were established, often at places at considerable distances from towns and villages, where their inhabitants were compelled to make their purchases. According to a report made by the comptroller-general in 1787, the salt tax at that time annually occasioned "four thousand domiciliary seizures, three thousand four hundred imprisonments, and five hundred sentences to flogging, exile, and the galleys."

But in addition to the so-called national system, which imposed a great variety of taxes upon all persons and property in France which could not through favor procure exemption, which exemption embraced practically all the nobility, clergy, and gentry, there were a great number of taxes peculiar to separate estates or seigniories, but at the same time more or less general. Thus, all the various operations involved in production and consumption were made, as far as possible, the occasion for tax assessments. The tenants, or vassals, were bound to grind their corn at the mill of the seigneur only; to bake their bread exclusively at his ovens; to press their grapes and apples exclusively at his presses; and for every such industrial conversion a toll or tithe was collected. One of the memoirs touching the condition of the Tiers État, as the common people were called, published about the time of the meeting of the National Convention, expresses a hope that posterity may be ignorant that feudal tyranny in Brittany, armed with judicial power, did not blush at breaking hand mills and selling annually to the miserable people the privilege of bruising between two stones a measure of buckwheat or barley.

Movements of persons or property from one town or parish to

another always involved taxation. If a farmer or laborer moved from one parish to another, it was held that he could not separate himself from a residence once adopted, but remained there for taxation, although he might actually and permanently have left it and be paying taxes in another place. All movements of property and persons were discouraged; and it not infrequently happened that there was grievous famine in some departments of France, and a surplus of food at the same time in others, not very far distant, because of the inability of producers in the latter to dispose of an abundant harvest for lack of any remunerative market or demand. Every sale or transfer of property also carried in it a payment to the seignior, or lord of the manor, to the extent of one eighth and sometimes one sixth of the entire equivalent received in consideration. And it is interesting here to note that this exaction was recognized and enforced in French Canada until the abolition of seignioral tenure, forty years ago. Arthur Young states that at the time he traveled in France, 1787–'89, the very terms used to designate the taxes imposed on the peasantry were in many instances untranslatable into English; and from a long list of such terms as he recorded, very few can be found and defined in any ordinary French lexicon.* In order, however, in some degree to satisfy curiosity as to the nature of these abominations, it may be mentioned that one of the local taxes in Brittany, which remained in force down to 1789, and was known as the "*silence des grenouilles*," was a money payment in lieu of an ancient feudal obligation incumbent on the residents of marshy districts to keep the frogs still, by beating the waters, that the lady of the seigneur might not be disturbed "when she lies in"; while another exaction, still more outrageous, which was not repealed until the French revolutionary convention in 1790 swept it from the statute book, was a tax known as *cuissage*, or "*droit du seigneur*," which was paid to the seignior as a substitute for his ancient and formerly undisputed right to the possession before marriage of the person of every female, the daughter of any of his serfs or more dependent vassals.†

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* Of such terms Mr. Young mentions the following as expressive of the tortures of the peasantry in Bretagne (Brittany) without attempting to define their exact meaning: "*Chevauches, quintaines, soule, saut de poisson, baiser de marices, chansons, transport d'œuf un charrette, silence des grenouilles, corvée à miséricordes, milods, leide, couponage, cartilage, borage, fouage, marechaussée, ban vin, ban d'aout, trousses, gelinage, civerage, taillabilité, vingtain, sterlage, bordelage, minage, ban de vendanges, droit d'accapite*," etc.

† This exaction, the reality of which has been called in question, would seem to be a necessary incidence or outcome of slavery or serfdom, inasmuch as the condition of slavery implies no rights on the part of a slave that the master is bound to respect. Mr. Thorold Rogers is authority for the fact that this *droit du seigneur* was recognized under

Another relic of old feudalism which prevailed in France down to the period of the Revolution, and which, indirectly a tax, was most oppressive and impoverishing to the French rural population, was an obligation termed the *corvée*, imposed upon them to keep the main roads of the kingdom in repair without being remunerated for their labor or for the services of their animals. They were thus frequently forced away with their teams from their fields, at the demand of any traveling noble or important personage in either church or state, and often at a time of sowing or harvesting, when they could be least spared; and were occasionally required to travel long distances in order to reach their allotted work. While they were thus compelled to keep the main roads of the kingdom in repair, which were generally of little use to them, the local or parish roads, on which they were dependent for their communication with adjacent towns or villages, were allowed by the Government to remain neglected.* For many years previous to the Revolution, the institution of the *corvée* undoubtedly meant to the French peasantry a period every year of from twelve to fifteen days of forced labor for the construction and repair of roads, for which the nobility, clergy, and town merchants contributed not a sou, or an hour of work.

And now comes an exceedingly interesting but little-known chapter in French history. There were men of large hearts and great intelligence in France during the reign of Louis XIV—1643–1715—who were not only keenly appreciative of the oppressions and sufferings of the French people by reason of their horrible system of taxation, but also of the certain destructive influence of this system on the industry, society, and government of the kingdom.† Among these was the celebrated Marshal Vauban, who, although a soldier by profession, and holding one of the highest offices among the privileged nobility, had made a study of the misery of his countrymen, and had discerned in a great degree its cause, and was seeking for its remedy. The knowledge that his office as marshal of France gave him of the necessity for great expenditures—the country being almost always at war—and the little hope he had that the king would retrench in matters of splendor and amusement, left him no other alternative but to try

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various names, as *jambage*, *mercheta*, and *mantagium*, in France in the thirteenth and fifteenth centuries, and that fines in recognition and in lieu of this ancient manorial right were probably paid in England almost as late as the administration of Cromwell.

* This practice or institution of the *corvée* was undoubtedly of ancient Eastern origin, and until recently existed in Egypt; a very considerable part of the labor employed in constructing the Suez Canal having been performed, in accordance with the orders of the then ruling Khedive, under its conditions.

† During the eighteenth century famine periodically decimated the rural population of France, and forty million acres went out of cultivation.

to find some method by which the burden of the multitudinous taxes imposed for defraying these expenditures might not be enormously and unnecessarily augmented by their method of taking. He accordingly proposed what was in effect a *single tax*—namely, that the king should annually take by one act or payment a royal tithe or tenth—*dixme royale*—of all the property of each community, or of each person in the kingdom; and that this simple and sole tax, which would suffice for all, and which would pass directly into the coffers of the king, should be the means by which every other form of tax or exaction from the people, with all its complicated, inquisitorial machinery for collection, should be abolished. About the same time a lieutenant-general of France—one Boisguilbert, of Rouen—took up the investigation of the same subject, and published a really learned and profound book; in which he also proposed a new system of taxation, which he claimed would at once relieve the people of many taxes, and the state of the necessity of great expenditure, by providing that the proceeds of every tax should go at once into the treasury of the king, instead of enriching first the farmers-general, the finance ministers, and their deputies.

The system of Boisguilbert was analogous to that proposed by Vauban, with the exception that the former advocated the continuance of some taxes on foreign commerce and upon foods, and the latter desired especially to abolish all such forms of taxation.

Admirable in many respects as were these proposed reforms; clearly based as they undoubtedly were upon what are now recognized as sound economic principles, they had one great defect. They prescribed a course which if followed would have taken away the means of livelihood of a very large number of officials. It would have compelled them to live at their own expense, instead of at the expense of the public. This was enough to insure their failure. All the people whose interests, fortunes, and emoluments were threatened arrayed themselves in opposition; for they reasoned truly that place, power, wealth, and social position would fly from their grasp if the counsels of Vauban were to be followed. It is not to be wondered, then, that the king listened to the advice of the multitude who were privileged to talk with him, rather than to his one clear-headed, unselfish, faithful servitor; or that when Marshal Vauban presented him with a book embodying and explaining his fiscal views and system, he received it with a very ill grace. His ministers also, even if they were contrary disposed, which is not probable, could not do otherwise than follow the views of the king, and from that moment the splendid services of the marshal, his military genius, his virtues, the former affection the king had had for him—all were forgotten. He stood in the position of one courting the favor of the people, and con-

temning and weakening lawful authority. The circulation of his book was forbidden, and all the copies which the state could reach were destroyed; while the unhappy marshal, unable to survive the loss of the king's favor, or stand up against the enmities he had created, soon died of a broken heart.

His friend Boisguilbert, whom these events ought to have made prudent, could not restrain himself, but published a book vindicating Vauban, and answering one of the principal objections to his system—namely, the impracticability of making any radical changes during a great war—by asking if it was necessary to wait for peace before abolishing great abuses. This was a more offensive contemning of authority than Vauban had committed; and Boisguilbert was stripped of his functions, severely reprimanded, and sent into exile. For this he was in a degree recompensed by the acclamations and approbation of the people wherever he went.

The system and abuses which Vauban and Boisguilbert endeavored to reform accordingly continued; but as years went on, and the misfortunes of France accumulated and culminated in the total defeat of her armies by Marlborough, the necessity of larger revenues to meet larger expenditures became most urgent; but how to provide them was a problem which brought no little embarrassment to Louis XIV's ministers. At last Desmarets, who was Comptroller-General of the Finances, proposed to the Council of State, as a way out of their difficulties, that they should, *in addition* to all existing numerous and abominable taxes, establish or take on the system of a royal tenth, which had been proposed by Vauban and Boisguilbert as a substitute for all other taxes; with all the new machinery, officials, and valuations which such a system entailed. The proposition, after a brief consideration, was approved by the Council, and Desmarets was authorized to present it to the king; who, although long accustomed to various and extravagant exactions, is related at first to have been greatly terrified, and to have exhibited for some eight or ten days a profound melancholy. At the expiration of this period he regained his usual calmness, and gave the following explanation of the cause of his trouble: He said that he had been much tormented that the extremity of his affairs required him to take so much of the wealth of his subjects; and that at last he unbosomed himself to the Père Tellier (his confessor); who after a few days returned and reported that he had laid the matter before the most eminent doctors (theologians) of the Sorbonne, by whom it was decided, *that all the wealth of his subjects was the king's, and that when he took of it he only took what belonged to him.* The king added that this decision had taken away all his scruples, and had restored to him all the calm and cheerfulness that he had lost. After

the king had been thus satisfied by his confessor, no time was lost in establishing the tax. The effect upon the masses was one of great sadness, but there was no revolt. Many of the property holders in the kingdom endeavored to convince the state officials that under the former condition of affairs they did not enjoy a tenth part of their income, and representatives of the province of Languedoc offered to give up its entire wealth to the crown, if they might be allowed to enjoy, free of every tax, the tenth part of it. All these remonstrances and propositions were not only *not* listened to, but their presentation was regarded in the light of insubordination.

The product of this new tax was not nearly so much as had been expected; and its most marked result was, that it enabled the king to augment all his infantry to the extent of five men per company.

In this record of tax experience, which, commencing at least as far back as 1667, under Louis XIV, continued with increasing popular oppression and misery until 1789, we find the origin and the horrors of the French Revolution which began in the latter year. During its continuance six thousand persons, mostly of the ranks of the nobility, clergy, and gentry, are said to have perished under the hands of public executioners and upon the scaffold. But when one calls to mind the multitudes that, for many successive generations, were starved and tortured out of existence by a system of exactions under the name of taxation, and for which system the king, the nobility, the clergy, and the influential classes of France were responsible, the wonder is, that the masses of a brutalized and infuriated people should have shown so much clemency and restraint in the hour of their vengeance and of triumph.*

* On this point, Arthur Young, whose observations on the condition of the French people were made before the great revolution had culminated, or in 1789, writes: "It is impossible to justify the excesses of the people or their taking of arms. They were clearly guilty of great cruelties. But is it really the people to whom we are to impute the whole, or to their oppressors, who had kept them so long in a state of bondage? He who chooses to be served by slaves, and by ill-treated slaves, must know that he holds both his property and life by a tenure far different from those who prefer the service of well-treated freemen; and he who dines to the music of groaning sufferers, must not, in the moment of insurrection, complain that his daughters are ravished and then destroyed, and that his sons' throats are cut. When such evils happen they surely are more imputable to the tyranny of the master than to the cruelty of the servant. The analogy holds with the French peasants. The murder of a seigneur, or a château in flames, is recorded in every newspaper. The rank of the person who suffers attracts notice. But where do we find the register of that seigneur's oppressions of his peasantry, and his exactions of feudal service from those whose children were dying around them for want of bread? Where do we find the minutes that assigned these starving wretches to be fleeced by impositions, and a mockery in the seigneural court? Who gives us the award of the intendant and his sub-delegues, who

It is interesting also to note in this connection that against no one class, when the revolutionary element became ascendant in France, was popular hatred more intense than to the farmers-general, to whom the collection of taxes in the different provinces of the kingdom was farmed out or contracted. The extravagant expenditure which, as a rule, characterized their living, was regarded by the masses as all-sufficient evidence of the enormous profits unjustly accruing to them from these contracts; and the power continually exercised by their agents to make domiciliary visits, seize goods, inflict fines, and take other measures of an arbitrary, obnoxious character to enforce compliance with extortions, all contributed to make them objects of execration by nearly the entire people. And this animosity under the revolutionary government speedily manifested itself, by sending thirty-two out of the whole number—sixty—of these high officials to the guillotine; among whom were undoubtedly some honest and conscientious financiers and otherwise distinguished men, such as Lavoisier, the father of modern chemistry.

One of the great results of the French Revolution, which ought to be duly weighed in reckoning up the good and evil of that mighty popular convulsion, is that it swept away the feudal land laws of old France and made landowners of several millions of men who were formerly serfs. Fully one half of the land of France at the present time is owned by small farmers or peasants; and in their hands has been demonstrated afresh what Arthur Young called the magic power of property to turn sand to gold. Regions which he visited in 1788, and found barren and deserted, a hundred years later were clothed with vines and gardens under the tillage of peasant proprietors.

From the foregoing consideration of France in the last century, experiencing through the abuse of taxation the most awful revolution in history, let us turn to a country of our own time and continent, and observe methods of taxation yet surviving the vigor and barbarism of the mediæval period.

Taxation in Mexico.—Until recently, and to a great extent at present, the system of taxation operative in Mexico, the origin or evolution of which may in no small part be attributed to a sparseness of population, lack of accumulated wealth or capital, limited wants, and low civilization of the masses, is especially worthy of notice, and most instructive from the circumstance that nothing like it exists in any other country.

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took off the taxes from the man of fashion, and laid them with accumulated weight on the poor who were so unfortunate as to be his neighbors? Who has dwelt sufficiently on explaining all the ramifications of despotism, regal, aristocratical, and ecclesiastical, pervading the whole mass of the people, reaching like a circulating fluid the most distant capillary tubes of poverty and wretchedness?"—*Young's Travels in France.*

The duties levied on imports into Mexico are so excessive that the *average* rate of the Mexican tariff is probably greater than that adopted by any other country claiming to be civilized, with the possible exception of Russia. The favorite modern idea of making the tariff subserve two purposes—namely, the raising of revenue and the regulation of trade—does not appear as yet to have greatly interested either the people or Government of Mexico, as revenue, through the necessities of the state, is the supreme consideration; and for securing this no other rule seems to have been recognized and followed in imposing duties on imports than that the higher the duty (or tax) the greater will be the accruing revenue.

But with this general characterization of the Mexican tariff there comes in the following other most anomalous feature: Thus, in all commercial countries, save those which permit the levy by certain municipalities of the so-called *octroi* taxes, when foreign articles or merchandise have once satisfied all customs requirements at a port, or place of entry, and have been permitted to pass the frontier, they are exempted from any further taxation *as imports* so long as they retain such a distinctive character. In the United States, for example, it is held that the right to import carries with it a right to sell (i. e., in the original packages) without further restrictions. And the Supreme Court of the United States has decided that a license tax imposed by a State of the Federal Union, as a prerequisite to the right to sell an imported article, is equivalent to a duty on imports, and in violation of the provision of the Federal Constitution which prohibits the States from imposing import duties; and this decision has been carefully recognized by the authorities of the several States in dealing with imported liquors under local license, or other restrictive laws.

But, in Mexico, each State of the republic has had practically its own custom-house system, and levies taxes on all goods—domestic and foreign—passing into its territory for the purpose of use or consumption; and then, in turn, the several towns of the States again assess all goods entering their respective precincts. The rate of State taxation, being determined by the several State legislatures, varies, and varies continually, with each State. In the Federal District—i. e., the city of Mexico—the rate was recently two per cent of the national tariff; but in the adjoining State of Hidalgo it was ten per cent, and in others it has been as high as sixteen per cent. The rate levied by the towns is said to be about nine per cent of what the State has exacted; but in this there is no common rule. Nor is this all. For the transit of every territorial boundary necessitates inspection, assessment, the preparation of bills of charges, and permits for entry; and all these trans-

actions and papers involve the payment of fees, or the purchase and affixing of stamps. Thus, by section 377 of the tariff law of December, 1884, it is ordained that "the custom house shall give to every individual who makes any importation, upon the payment of duties, a certificate of the sum paid, which certificate, on being presented to the administrator of the stamp office in the place of importation, shall be changed for an equal amount in custom-house stamps. For this operation the interested party shall pay, to the administrator of whom he received the stamps, two per cent in money (coin) of the total value of the stamps." All imports into Mexico are liable, therefore, to these multiple assessments; and the extent to which they act as a prohibition on trade may be best illustrated by a practical example.

In 1885 an American gentleman, residing in the city of Mexico as the representative of certain New England business interests, with a view of increasing his personal comfort, induced the landlady of the hotel where he resided (who, although by birth a Mexican, was of Scotch parentage) to order from St. Louis an American cooking stove, with its customary adjuncts of pipes, kettles, pans, etc. In due time the stove arrived; and the following is an exact transcript of the bills contingent, which were rendered and paid upon its delivery:

ORIGINAL INVOICE:

1 stove.................................. weight 282 pounds.		
1 box pipe.................................. " 69 "		
1 box stove furniture.................................. " 86 "		
Total.................................. 437 pounds, or 199·3 kilos.		
Cost in St. Louis, United States currency..................	$26 50	
Exchange at 20 per cent..................	5 30	
Total..................	$31 80	
Freight from St. Louis to city of Mexico (rail), at $3.15 per 100 pounds	$15 75	
Mexican consular fee at El Paso..................	4 85	
Stamps at El Paso..................	45	
Cartage and labor on boxes examined by custom house at El Paso.....	50	
Forwarding commission, El Paso..................	2 00	
Exchange 16⅔ per cent on $7.64 freight advanced by Mexican Central Railroad..................	1 25	
		$56 60

IMPORT DUTIES:

1 box, 128 kilos (stove), iron, without brass or copper ornaments, at 19 cents per kilo..................	$24 42
1 box, 31·3 kilos, iron pipe, at 24 cents per kilo..................	7 51
1 box iron pots, with brass handles, at 24 cents per kilo..................	9 48
	$41 41
Add 4 per cent as per tariff..................	1 65
	$43 06
Package duty, 50 cents per 100 kilos..................	1 00
	$44 06

Add 5 per cent as per tariff	$2 20	
	$46 26	
Add 2 per cent municipal duty	93	
	$47 19	
Add 5 per cent consumption duty	2 36	
	$49 55	
Dispatch of goods at Buena Vista station, city of Mexico	38	
Stamps for permit	50	$50 43
		$107 03
Cartage in city of Mexico		75
Total		$107 78

Résumé:

Original cost of stove, with exchange	$31 80
Freight, consular fees, and forwarding	24 80
Import duties	50 43
Cartage	75
Total	$107 78

Under such a system articles of the most common use in the United States are from their increase of price necessarily made articles of luxury.

Again, the Mexican tariff provides that the effects of immigrants shall be admitted free. "But this is rendered practically a dead letter, from the fact that the interior duties are levied on everything the immigrant has before he gets settled; and these are so heavy that immigration has been greatly discouraged. A carpenter, or other mechanic, who desires to get employment in Mexico, has such heavy duties levied on his tools on passing the national or State frontiers that few are willing or able to pay them. Hence, few American mechanics find their way into the country, unless in accordance with special contract."

The existence in a state of the New World of a system of taxation so antagonistic to all modern ideas, and so destructive of all commercial freedom, is certainly very curious, and prompts to the following reflections: First, how great were the wisdom and foresight of the framers of the Constitution of the United States in providing, at the very commencement of the Federal Union, that no power to tax in this manner, and for their own use or benefit, should ever be permitted to the States that might compose it (Article I, section 10). Second, how did such a system come to be ingrafted on Mexico, for it is not a modern contrivance? All are agreed that it is an old-time practice and a legacy of Spanish domination. But, further than this, may it not be another of those numerous relics of European mediævalism which, having utterly disappeared in the countries of their origin, seem to have become embalmed, as it were, in what were the old Spanish

provinces of America—a system filtered down through Spanish traditions from the times when the imposition of taxes and the regulation of local trade were regarded by cities and communities in the light of an affirmation of their right to self-government, and as a barrier against feudal interference and tyranny; and when the idea of protecting industry through like devices was not limited as now to international commerce, but was made applicable to the commercial intercourse of cities and communities of the same country, and even to separate trades or "guilds" of the same city? Whether such speculations have any warrant in fact or not, it is at least certain that we have in the Mexico of today a perfect example of what was common in Europe in the middle ages; namely, of protection to separate interests (through taxation) carried out to its fullest and logical extent, and also of its commercial and industrial consequences.

So much for the tariff system of Mexico and its adjuncts. The "excise" or "internal revenue" system of the country is no less extraordinary. It is essentially a tax on sales, collected in great part through the agency of stamps, and is a repetition of the old "*alcalvala*" tax of Spain, even to the extent of retaining its name slightly modified from *alca vala* to "*alca bala*"; and which Adam Smith, in his Wealth of Nations, describes as one of the worst forms of taxation that could be inflicted upon a country, and as largely responsible for the decay of Spanish manufactures and agriculture. Thus a Federal statute of Mexico, enacted in 1885, imposed a tax of "one half of one per cent upon the value in excess of twenty dollars of transactions of buying or selling of every kind of merchandise, whether at wholesale or retail, in whatever place throughout the whole republic." Also, one half of one per cent "on all sales and resales of country or city property; upon all exchanges of movable or immovable property; on mortgages, transfers, or gifts, collateral or bequeathed inheritances; on bonds, rents of farms, when the rent exceeds two thousand dollars annually; and on all contracts with the Federal, State, or municipal governments." Every inhabitant of the republic who sells goods to the value of over twenty dollars must give to the buyer "an invoice, note, or other document accrediting the purchase," and affix to the same, and cancel, a stamp corresponding to the value of the sale. Sales at retail are exempt from this tax; and retail sales are defined to be "sales made with a single buyer, whose value does not exceed twenty dollars. The reunion, in a single invoice, of various parcels, one of which does not amount to twenty dollars, but which in the aggregate exceed that quantity," remains subject to the tax. Retail sales in the public markets, or by ambulatory sellers, or licensed establishments whose capital does not exceed three hundred dollars, are also exempt.

Tickets of all descriptions—railroad, theater, etc.—must have a stamp, as must each page of the reports of meetings, each leaf of a merchant's ledger, day or cash book, and every cigar sold singly, which must be delivered to the buyer in a stamped wrapper. Sales of imported spirits pay eight per cent on the duties levied on their importation, and a half of one per cent in addition when retailed. Domestic spirits pay three per cent when sold by producers or dealers at wholesale, and a half of one per cent additional when sold at retail. Gross receipts of city railroads pay four per cent; public amusements, two per cent upon the amount paid for entrance; playing cards, fifty per cent—paid in stamps—on the retail price; and manufactured tobacco a variety of taxes, proportioned to quality and value. Mercantile drafts are taxed at a dollar on every hundred.

Farms, *haciendas*, and town estates are required to be taxed at the rate of three dollars per each thousand dollars of the valuation, but such is the influence of the landowners that the valuation is almost nominal. In Vera Cruz the rate is reported at about two mills on the dollar for the most productive portions of country estates; while in the Pacific State of Colima the rate is said to be one and a half per cent. Land and buildings not actually producing income are exempt from taxation, notwithstanding they may be continually enhancing in value. This system of exempting unoccupied realty from taxation also prevails in Portugal; and the Mexican usage was probably derived from that country, where the theory in justification of the practice is, that the use of a thing defines its measure of value, and that to tax unused property is confiscation.

A recent Mexican statute for the taxation of land contains forty-seven different sections, each providing the ways and means of enforcing the tax and prescribing penalties for its infraction. In the towns and cities of Mexico this system of infinitesimal taxation is indefinitely repeated, the towns acting as collectors of revenue for the Federal and State governments, as well as for their own municipal requirements. All industries pay a monthly fee: As tanneries, fifty cents; soap factories, one dollar. So also all shops for the sale of goods pay according to their class, from a few dollars down to a few cents per month. Each beef animal, on leaving a town, pays fifty cents; each fat pig, twenty-five cents; each sheep, twelve cents; each load of corn, fruit, vegetables, or charcoal, six cents (as a supposed road tax), and so on; and, on entering another town, all these exactions are repeated. A miller, in Mexico, it is said, is obliged to pay thirty-two separate taxes on his wheat before he can get it from the field and offer it, in the form of flour, on the market for consumption. As a matter of necessity, furthermore, every center of popu-

lation—small and big, city, town, or hamlet—swarms with petty officials, who are paid to see that not an item of agricultural produce, of manufactured goods, or an operation of trade or commerce or even a social event, like a *fandango*, a christening, a marriage, or a funeral, escapes the payment of tribute.

In fact, trade has been so hampered by this system of taxation that one can readily understand and accept the assertion that has been made, that people with capital in Mexico really dread to enter into business, and prefer to hoard their wealth, or restrict their investments to land (which, as before pointed out, is practically exempt from taxation), rather than subject themselves to the never-ending inquisitions and annoyances which are attendant upon almost every active employment of persons and capital, even were all other conditions favorable. Mexico, from the influence of this system of taxation alone, must, therefore, remain poor and undeveloped; and no argument to the contrary can in any degree weaken this assertion. Doubtless there are many intelligent people in Mexico who recognize the gravity of the situation, and are most anxious that something should be done in the way of reform. But what can be done? If autocratic powers were to be given to a trained financier, thoroughly versed in all the principles of taxation and of economic sciences, and conversant with the results of actual experience, the problem of making things speedily and radically better in this department of the Mexican state is so difficult that he might well shrink from grappling with it.

In the first place, the great mass of the Mexican people have little or no visible tangible property which is capable of direct assessment.

Again, in any permanent system of taxation, taxes in every country or community, in common with all the elements of the cost of production and subsistence—wages, profits, interest, depreciation, and materials—must be substantially drawn from each year's product. Now, the annual product of Mexico is comparatively very small. Thus, for example, the annual product of one of the least developed States of the Federal Union—South Carolina—was in 1888 absolutely two and a half times—or, proportionally to area, twenty-five times—as valuable as the then annual product of the entire northern half of Mexico; and the Argentine Republic of South America, with only one third the population of Mexico, has a revenue twenty per cent greater, and double the amount of foreign commerce. Product being small, consumption must of necessity be also small. "The average cost of living (food and drink) to a laboring man in the city of Mexico is about twenty-five cents per day; in the country, from twelve and a half to eighteen cents. The average annual cost of a man's

dress is probably not over five dollars; that of a woman, double that sum, with an undetermined margin for gewgaws and cheap jewelry." Mr. Lambert, United States consul at San Blas, reported under date of May, 1884: "The average laborer and mechanic of this country may be fortunate enough, if luck be not too uncharitable toward him, to get a suit of tanned goatskin, costing him about six dollars, which will last him as many years." Of household goods, the mass of the Mexican people are almost destitute. A few untanned hides are used for beds, and dressed goat or sheep skins serve for mattress and covering.

The food of the masses consists mainly of agricultural products—corn (*tortillas*), beans (*frijoles*), and fruits—which are for the most part the direct results of the labor of the consumer, and not obtained through any mechanism of purchase or exchange.

Persons conversant with the foreign commerce of Mexico are also of the opinion that not more than five per cent of its population buy at the present time any imported article whatever, and that for all purposes of trade in American or European manufactures, the consuming population is not much in excess of half a million. Revenue in Mexico from any tariff on imports must therefore be limited, and this limitation is rendered much greater than it need be by absurdly high duties, which (as notably is the case of cheap cotton fabrics) enrich the smuggler and a few mill proprietors to the great detriment of the national exchequer.

It is clear, therefore, that the basis available to the Government for obtaining revenue through the taxation of articles of domestic consumption, either in the processes of production or through the machinery of distribution, is of necessity very narrow; and that if the state is to get anything, either directly or indirectly, from this source, there would really seem to be hardly any method open to it other than that of an infinitesimal, inquisitorial system of assessment and obstruction akin to what is already in existence.

But the greatest obstacle in the way of tax reform in Mexico is to be found in the fact that a comparatively few people—not six thousand out of a possible ten million—own all the land and constitute in the main the governing class of the country, and the influence of this class has thus far been sufficiently potent *practically* to exempt land from taxation. So long as this condition of things prevails it is difficult to see how there is ever going to be a middle class (as there is none now worthy of mention) occupying a position intermediate between the rich and a vast ignorant lower class that take no interest in public affairs, and is only kept from turbulence through military restraint. Such a class in every truly civilized and progressive country is numerically the largest, and comprising the great body of producers, consumers,

and taxpayers, is the one most interested in the promotion and maintenance of good government. A tax policy, however, which would compel the landowners to cut up and sell their immense holdings, especially if they are unwilling to develop them, would be the first step toward the creation of such a middle class. But it is not unlikely that Mexico would have to go through one more revolution, worse than any she has yet experienced, before any such result could be accomplished. At present, furthermore, there is no evidence that the mass of the Mexican people, who would be most benefited by any wise scheme for the partition of the great estates and for tax reform, feel any interest whatever in the matter or would vigorously support any leader of the upper class who might desire to take the initiative in promoting such changes; and herein is the greatest discouragement to every one who wishes well for the country.*

THE PYGMY IN THE UNITED STATES.

By JAMES WEIR, Jr., M. D.

IT is highly probable that at one time or another most of the civilized nations of the world knew of certain small, undersized men, and that they constructed and built up legends and myths about them. The ancient Talmudic writers, however, were probably unacquainted with these little people, for nowhere in the Old Testament nor in any of the ancient Hebrew writings are they mentioned. The giant plays a prominent part in more than one biblical drama, but his direct opposite, the pygmy, never appears in any rôle. But long before the Israelitish captivity and exodus, and thousands of years before the five Nasamonians of Herodotus made their memorable journey of exploration into the deserts of Libya, the earliest of known historiographers, the Egyptians, had made his acquaintance, and had made note of his peculiarities of form. Marriette Bey has seen the figure of a pygmy on a monument of the old empire, and

* During the year 1892 the present enlightened President of the Mexican Republic, fully recognizing the great obstruction to trade and commerce which the complicated tax system as above described entails upon the country, created a commission of eminently qualified persons to consider the subject with a view of instituting a better fiscal system. And as one result of its investigations the present Congress of Mexico has adopted an amendment to its Federal Constitution, by which the *alcabalas* shall be definitely abolished in the course of the present year, 1896. Every State in Mexico is accordingly now engaged in modifying its old system of taxation and replacing it with something better. So far as the city of Mexico is concerned, direct taxes have already been substituted for the *alcabalas* on a number of important revenue-producing articles, as, for example, on brandy, alcohol, and pulque.

has deciphered his name, *Akka* (the name by which he is known to this day), written beside him.

The legend of the storks and the pygmies has been familiar to us since our earliest childhood, and I dare say many of us believed in it with a child's unhesitating belief for some years after we had escaped from the thralldom of the nursery. I know that I did, and whenever I would see cranes winging their way southward I would conjure up a mental picture of an army of little men mounted on rams and goats, and engaged in a sanguinary battle with myriads of cranes. I would then lift up my childish voice and shriek out the warning, "Beware of the pygmies!" to the birds flying high above my head. Homer is the first of the classical writers who makes mention of this legend, and he probably borrows from beliefs much older than his time. Says he in the Iliad, Book III, when speaking of the advancing Trojans, whom he likens to a cloud of birds:

> Thus by their leader's care, each martial band
> Moves into ranks, and stretches o'er the land;
> With shouts the Trojans, rushing from afar,
> Proclaim their motions, and provoke the war;
> So when inclement winters vex the plain
> With piercing frosts, or thick descending rain,
> To warmer seas the cranes embodied fly,
> With noise and order, through the midway sky:
> To pygmy nations wounds and death they bring,
> And all the war descends upon the wing.
>
> POPE.

Although Homer does not mention the country of the pygmies in this passage, he does say that the cranes "fly over the ocean" (Pope takes advantage of a poet's license and does not give a literal translation); hence he must have located them unquestionably in Africa.

Aristotle, in his History of Animals, mentions these little men in his description of storks. After stating that these birds pass from Scythia to the marshes of Egypt, "toward the sources of the Nile," he declares that "this is the district that the pygmies inhabit, whose existence is not a fable." A hundred years before Aristotle, however, Herodotus had written of these homuncules, for he says that certain Nasamonians, five in number, had conceived the idea of exploring the deserts of Libya. After they had been traveling in the desert for several days they saw trees in the distance. They made toward these welcome objects, and when they had reached them, and while they were eating the fruit which grew on them in great abundance, they were suddenly surrounded and seized "by a large company of very small men who were much below the average height, and who dragged them

away with them. They did not understand the language of the Nasamonians, nor did the latter understand that of their captors. They were conducted by these little men across a marshy country, into a town whose inhabitants were black. A large stream flowed before this town from west to east, and there were crocodiles in it."

Authorities now unhesitatingly state that this river could have been no other than the Djoliba, or Niger as it is called by cartographers and geographers. This river rises in a cañon of

Tasmanian. From The Pygmies, Quatrefages.

the mountainous plateau of eastern Senegambia, where it is known as the Djoliba or Joliba, flows northeast, then west, and then southeast, to empty into the Gulf of Guinea near Cape Formosa.

In the neighborhood of Timbuktu, 18° 5′ 10″ north latitude, and 40° 5′ 10″ west longitude; the river flows from west to east. Says De Quatrefages, in Pygmies: "There" (Timbuktu) "the river bends abruptly, and flows almost directly from west to east as far as Bourroum, over a distance of over three degrees of longitude, before turning toward the south to reach the Gulf of Guinea. It is, then, between the first and the fourth degree of

west longitude that the Nasamonea reached the Niger." (It should be noted here that a large proportion of our former slave population was brought from a section of Africa only a degree or so south and east of Timbuktu.) The above-quoted author very correctly states that the town in which the Nasamonians were held captave could not have been the famous Timbuktu, for Ahmed Baba, the celebrated Arab historian and annalist, declares that the town was not founded until the fifth century of the Hegira, or 1100 A. D. But, taking everything into consideration, I am inclined to believe that it was really in this neighborhood that these adventurous explorers met the pygmies, and that the latter at that time had a town on the banks of the river Niger. The incursions of stronger and more warlike peoples probably drove these little men southward, out of the immediate neighborhood of the present site of Timbuktu.

The older writers, notably Pliny, located the pygmies in more than one country. Pliny not only locates them in Africa, but also in India, and modern research has declared that this historian was correct.

In the Vindhya Mountains, Malwa, India (20° to 25° north latitude, and 75° to 80° east longitude), M. Rousselet has found the *Bandra Loks* ("man monkeys"), true pygmies, less than five feet in height. These people are, unquestionably, *bona fide* negritos ("little negroes"). Saint-Pol Lias also found negritos in the province of Perak, called *Sakaies*. These little negroes were all five feet or under, and presented all the characteristic marks of the African pygmies, with the single exception of the protuberant abdomen. This modification of form is probably due to their surroundings. Not only are the negritos to be found in India, but they are to be observed in the Andaman Islands, Bay of Bengal; in the Malayan Archipelago; in Melonesia and Polynesia; and in Australia. This race has penetrated as far north as Japan, for Dr. Maget has found true negritos among the Japanese. They are also to be found in the archipelago of Loo Choo and in Formosa.

The Andamanese probably approximate more nearly in stature and form the pygmies of the United States than do any other tribe of little people save the *Akka* and *Bushmen* of Africa. The Tasmanians, however, resemble our negritos very much, as far as facial angle and expression are concerned. I have, therefore, introduced the portrait of a Tasmanian for the sake of comparison. In recent times explorers have penetrated Central Africa, and have found the smallest of all little people in the region of the country ruled over by King Munza, sovereign of the Monbuttos (1868–1871). Here Schweinfurth found a small colony of pygmies supported by King Munza; their chief, Adimokoû, told Schwein-

furth that his race dwelt farther south. From information given him by this negrito chieftain, this eminent traveler and scientist came to the conclusion that the country of the pygmies was situated about 30° north latitude and 25° east longitude. (I may state, parenthetically, that the pygmies of Africa are called *negrillos* by some anthropologists; why, I know not, for it is generally conceded that the eastern and western pygmies are generically of the same stock. If this be denied, the doctrine of polygenesis must be accepted as true. But while a firm believer in polygenesis, I yet believe that these widely separated tribes of negritos originally sprang from the same root-stock. Their dissemination over such a wide area has been due to one of two causes: either, in times long past, some of them have been carried across the Indian Ocean by storms, or at one time Africa extended across the ocean even as far as Australia. The mighty cataclysm that changed the *Sea* of Sahara into the *Desert* of Sahara, by elevating the northern portion of Africa, probably occasioned a corresponding subsidence, and the eastern portion of the continent, save Australia, the Andaman Islands, and the Malayan Archipelago, was covered by the ocean.)

AKKA. From The Pygmies, Quatrefages.

Chaillé-Long says, in Three Prophets, when returning from the country of King Munza: "I brought back with me, besides the six hundred Niam-Niam warriors, who had joined me in the battles against inimical tribes, . . . a specimen adult woman of the Ticki-Ticki, or Akka pygmy race. Ticki-Ticki is now in Cairo, and is a favorite plaything—being quite an acrobat—in the harem of the Khedive's mother." That adventurous Frenchman and most entertaining writer, Paul du Chaillu, met with pygmies at Niembonai, latitude 1° 58′ 54″ south, and longitude 11° 56′ 38″ east. Here they were known as *Obongos*. He says, in Equatorial Africa, that during his stay in the village of Niembonai he succeeded in measuring six adults, all women save one—a young adult man. The height of the women ranged from four feet four and a half inches to five feet, while the height of the young man was four feet six inches. Finally, Stanley came across these little people at Avatiko, a village near the river Lenda. Two of the pygmies, a man and a woman, were captured by his men and car-

ried into camp. The height of the man was four feet; his hands and feet were small and delicate; his body was rounded and well-proportioned, and his abdomen protuberant; the hair on his body was almost furlike, being nearly half an inch in length. On viewing this little man, Stanley rhapsodizes as follows: "Not one London editor could guess the feeling with which I regarded this manikin from the solitudes of the vast African forest. To me he was more venerable than the Memnonium of Thebes. That little body of his represented the oldest types of primitive man, descended from the outcasts of the earliest ages—the Ishmaelites of the primitive race—forever shunning the haunts of workers, deprived of the joy and delight of the home hearth, eternally exiled by their vice to live the life of human beasts in morass and fen and jungle wild. Think of it! Twenty-six centuries ago his ancestors captured the five young Nasamonian explorers, and made merry with them, at their village on the Niger" (In Darkest Africa). Stanley saw pygmies on several occasions after this, and Emin Pasha gives some interesting measurements in Stanley's book; so, I think, from the evidence adduced, that we can safely assert that there are tribes of pygmies, both continental and insular, in Asia, and that they are likewise still extant in Africa. All of these little negroes, both in Asia and in Africa, have certain anatomical, physiological, and skeletal characteristics in common, which declare that originally they must have come from the same stock. The true negro is dolichocephalic (long-headed); is of an average height as compared with the white race; his form is not rounded, but, on the contrary, is generally spare and angular; he is not at all hairy, and a strong, acrid, hircic, and disgusting odor emanates from his person. The negrito or pygmy, wherever found, is, on the contrary, brachycephalic (round-headed) or subbrachycephalic; he is far below the average height; his form is rounded; his body is generally covered with a soft, downy fell, and no appreciable odor is given off from his person. The true negro has large feet and hands, while in the negrito these members are small and delicately shaped.

While looking over some old papers published in New Orleans in 1842, I found a short description of a batch of, presumably, freshly imported slaves. Among them were "six or eight very small negroes, men and women, all of whom were under five feet in height. Who ran in this cargo is not known, but Mr. —— has the disposal of them." An old bill of sale, now in the possession of Mr. Wolfgang Werner, of Savannah, dated April 23, 1810, gives a description of two adult slaves, male and female, in which the height of the male is declared to be "four feet six inches (4 ft. 6 in.), and the female four feet three inches (4 ft. 3 in.)." Finally, in the possession of the Armistede family, of

Virginia, there is a letter dated "The Oaks," February 20, 1773, and written by Miss Judith Graeme to her friend Miss Sarah Armistede. In this letter Miss Graeme bewails the fact that "Pa has bought four of those trifling, good-for-nothing little 'ginny niggers,' who will steal the cloathes off your back if you give them half a chaunce." After giving a page or so of local gossip, Miss Judith closes her letter with a postscript anent the little negroes, who seemed to have aroused her bitterest animosity. Says she, "The biggest one of those nasty little 'ginny niggers' is not five feet high." Thus we see that over a hundred years ago negritos were brought to America and sold as slaves. For all I know to the contrary, these little negroes had been coming into the country ever since slavery was first instituted. This is probably the reason that pygmies are no longer found in the region of the Niger or in Ashantee. The incursions of the Arab slave dealers have driven them farther and farther inland, until they now inhabit the dense forest solitudes of equatorial Africa. I do not believe that any of the Akka have ever been brought to America and sold as slaves, for the evidence shows that they have occupied the same region of country (Central Africa) for hundreds of years, but negritos closely akin to them and springing from the same root-stock were undoubtedly brought from the west and east coasts of Africa and sold as slaves in America. The descendants of these negritos are our American pygmies, who can be found in large numbers either living in colonies like that in the neighborhood of Charleston, S. C., or Bayou Goula, La., or scattered along the South Atlantic and Gulf seaboards. Hon. W. T. Ellis, member of Congress, who has made a study of these little negroes, says that they speak a language intelligible to themselves alone; that they have undoubtedly retained a large num-

A Pygmy of the United States.

ber of the words of their ancestral vocabulary; and that they have retained and make use of their original idioms. Of course, many English words have crept in, but these are so commingled with their native speech that their meaning is utterly lost unless one is familiar with the peculiar *patois* that these diminutive individuals make use of. Captain Ellis, of course, has reference to one particular colony, that near Charleston, S. C. In Louisiana these negritos use words borrowed from the French, but so corrupted that it would be difficult for the most expert philologist to trace out their derivation and meaning.

AMERICAN NEGRITO. Bayou la Têche, La.

Crossing has done much toward obliterating the pure type, many of these little people having only their undersized bodies and brachycephalic heads to indicate their origin; and, whenever there is a strain of negrito blood in an individual, he is very apt to possess one or both of these striking characteristics. I have examined a number of these half-breeds and have invariably found them round-headed and of short stature. In some localities, however, the pure type is very prevalent, and one may see the full-blooded negrito who possesses all the distinguishing features of his African or Asiatic brother. Such is the individual whom I have chosen to illustrate this paper. He was born in Bayou la Têche, La., of negrito parents, if his description of them is correct, and came to Kentucky with his "ole mistiss" when about fifty years old. He is four feet nine inches tall, and is perfectly proportioned. A glance at his photograph will show that his feet, notwithstanding the fact that they are covered by rough and unsightly brogans, are small and well made. His hands, although somewhat knotted by rheumatism and hard work, still show traces of their former slimness and delicate outline. His skin presents the characteristic texture of the full-blooded negrito, feeling like velvet to the touch, and is covered by a soft and downy fell. I have known him intimately for years, and have never detected the slightest odor emanating from his person. Finally, he is decidedly brachycephalic, and slightly

hypsistenocephalic. * (The vertical diameter is compared with the transverse diameter; when the former is equal to or exceeds the latter, the skull is hypsistenocephalic.) Notwithstanding his age (according to his count he is nearly seventy years old) he is quite strong and active. Mr. A. E. Davenport says that these negritos of the Southern States, notwithstanding their diminutive stature, are very strong and exceedingly active. De Quatrefages says the same of the Andamanese. I have examined a large number of these American pygmies, and have been very much surprised at their strength and agility.

In a number of localities, notably in Florida and Louisiana, the negrito has abandoned civilization and relapsed into savagery. He supports himself by hunting and fishing, and never leaves his haunts in morass and forest, unless compelled so to do by lack of ammunition or other necessary supplies. He is a devil worshiper, paying more attention toward propitiating the Evil One, in order to "keep out of his clutches," than to God, who does not need propitiation because he is good and merciful. Voudou and Walla-walla dances and incantation ceremonies are of almost nightly occurrence among these people. Every hollow tree, every tangled brake, and every miry morass is the dwelling place of either a ghost or an evil spirit. The fetich is greatly in evidence, every hunter carrying about with him some peculiarly formed root or stone, or perhaps a "conjure bag," which he wears securely tied about his neck, and which has been furnished him by some noted "conjure doctor." So much afraid of ghosts and spirits are these negritos that they will rarely leave their hovels at night. Whenever they do go out at night they never go alone, but always in companies. Courtship and marriage among these half-savage negritos possess some peculiarities which have partially originated with themselves; yet some of their customs in these social rites seem to be only modifications of similar ceremonies handed down to them by their ancestors. For instance, the young negrito man will leave a basket of fruit at the door of his sweetheart's hut some time during the night; if she takes it in the next day, he knows that his suit has met with favor. The *Sakies* of India and *Obongos* of Africa go through the same performance. Marriage, however, especially among the Florida negritos, is simply a mating of the two individuals. Where these little people still live in the neighborhood of towns and thickly settled portions of the country, they generally seek the services of a minister or magistrate, though not always.

The dead present awful and awe-inspiring attributes to the pygmies; the ghost of the departed is his *bête noire*; hence, when one of these individuals departs this life, his body is treated

with the greatest reverence. If he happens to be a negrito of the Bayou Goula, Bayou St. Martins, or Bayou la Têche neighborhood, or if he be one of those little people who dwell among the morasses and swamps of central Florida, his corpse is wrapped in bark, securely corded about with strips of hide, and hidden away in some secret place in the almost impenetrable forest. His ghost is supposed to linger in the neighborhood of his body; hence no negrito will ever approach the vicinity of his grave for fear of giving offense, and thereby incurring the enmity of the dead man, which would entail untold and unmentionable horrors.

These little men make splendid hunters, for they seem to have regained (if they have ever lost, which I greatly doubt) that acuteness of sight, smell, and hearing which makes their prototypes in India the very best of *shikaris*. There is no animal in all the woods their equal in cunning; there is no fish in any landlocked bayou or swiftly running stream which can avoid their rude but cunningly set nets and traps.

With their return to savagery these pygmies of the United States seem to have lost all desire for the comforts and refinements of civilization. Their huts among the moss-covered trees lining the bayous of Louisiana, or their still more miserable hutches in the Everglades of Florida, remind one very much of the pictured burrows of the *Akka*, their kinsmen, who dwell in the vast forest solitudes of Central Africa. Like that remnant of the Seminoles also living among the labyrinthine fastnesses of that vast waste of swamp, brake, and forest—the Everglades—these black manikins shun the haunts of men, and when discussing them one quotes almost involuntarily the thoughts of Stanley when he first saw the pygmy of Avatiko. When the wave of immigration turns southward, which it will eventually do, these little people will lose forever their individuality and become merged into the general population. Crossing will finally obliterate the pure type, but we will still continue to find, for an indefinite length of time, among our colored population, individuals with round heads and undersized bodies who will serve to show that once the pygmies dwelt among us.

SOME great advantages are claimed for the metal glucinum which may eventually give it a considerable position in electrical industry. Its resistance to traction is greater than that of iron, and its electrical conductivity is equivalent to that of silver. It should therefore have a greater mechanical resistance than iron, be a better conductor than copper, and, having a specific gravity of only 2, be lighter than aluminum; and these qualities, according to the *Journal des Inventeurs*, have been verified by experiment. Its commercial value is given as equivalent to about one hundred and sixty times less per volume and ten times less by weight than that of platinum.

PENDING PROBLEMS FOR WAGE-EARNERS.

By A. E. OUTERBRIDGE, Jr.

IN studying the important question of management of employees of industrial establishments from a common-sense as well as just and humanitarian point of view, it is necessary to remember that a factory is not an eleemosynary institution; the functions of the two are radically different, and experience has proved that modern manufacturing industries can not be practically conducted under the old idea of paternal or patriarchal regulations. The operative is jealous of his personal freedom and suspicious of purely philanthropic schemes originating within the establishment, and he resents any beneficial regulations savoring of charity. He does not complain of the strict enforcement of just rules, but he is quick to take advantage of laxity on the part of overseers, which, if continued, soon leads to chaos. On the other hand, unjust regulations can not be permanently enforced under the modern labor restrictions, for labor legislation in this country is extremely comprehensive, and takes cognizance of such infractions.* In some instances where labor legislation has been elaborated to a degree which was unduly oppressive to employers, it has served to restrict industrial development, reacting upon the intended beneficiary—the employee—and has necessitated the abandonment of such policy. The "granger legislation" relating to railroads in some of the Western States affords a well-known illustration of this tendency. Employees are no longer ignorant of their rights or privileges, and employers, as a rule, neither care nor dare to trample upon them; but experience has also proved that wherever numbers of men are massed together, a certain degree of strict rule is essential to the preservation of order and proper conduct of business.

Many of the rules and regulations of workshops and factories which appear harsh or unjust to the uninitiated are in reality necessary to protect the faithful employee from impositions of

* The labor laws differ greatly in the different States. Massachusetts has led the way in such legislation, and the other States are following in her footsteps. Most of these laws increase the responsibilities of employers, thus: Methods of protection from fire and accident must be provided in all factories and workshops, and employers can not by contract exempt themselves from liability for injuries to an employee. The buildings must be provided with proper sanitary arrangements; each room where machinery is placed must be connected with the engine room by speaking tubes, electric bells, or appliances to control the motive power.

The most minute regulations relating to the entire economic system of factory construction, operation, and inspection exist; and laws governing the payment of wages, exemption from fines or garnishment of wages or tools of trade for debts, etc., cover every phase of employment growing out of the factory system and are distinctly favorable to labor.

shirkers, of whom there are always a certain number even in the best-regulated establishments.

It is a favorite observation with writers on social and political economy that the world is continually passing through periods of "social evolution"; one of the latest and most popular of these authors (Benjamin Kidd) calls the present time "the most remarkable epoch in the history of human thought." Portents of impending changes in the established order of things, affecting the very foundations of society and the welfare of mankind, are frequently revealed to the innate perceptions of such writers; and it would seem from some of these—more especially the German authors—that the industrial world is now upon the verge of a social cataclysm, out of which a new civilization, the resultant of many opposing forces, would be evolved. Such prophecies (like Benner's) have hitherto apparently obeyed the "law of averages" with respect to the proportion of hits and misses; yet new forecasters of future social conditions, who believe that they perceive shadows of "coming events" cast before, continue to decipher these signs according to their introspective vision rather than through the light of past experience.

The fundamental principle of the Malthusian theory, that population tends to increase in geometrical progression and that the supply of food and other necessaries of life can only be increased in arithmetical progression, tersely expressed the social problem of Malthus's generation; but the subsequent wresting from Nature of virgin soil of vast extent in India, Russia, America, and other parts of the globe, affording feeding ground for countless flocks and herds, together with facilities for plowing, sowing, and reaping unlimited crops through the aid of modern agricultural machinery, and the modern methods of rapid distribution, changed all the former conditions, rendering the law inoperative during the century which has elapsed since its promulgation. Some of the more recent prophecies have proved equally abortive, and others are likely to share the same fate in the near future.

The growth of socialism in Europe during the past quarter of a century is one of the "signs of the times" which is just now affording a fruitful field for such speculations. If we permit ourselves to view the present state of civilization through the spectacles of some of these theorists, or if we countenance the foreign socialistic propaganda, we must, it seems to me, close our eyes to countless evidences of truly wonderful progress which has been made by the wage-earning class in America during this period in mental, moral, and material welfare. The operative of to-day is not only the peer but the superior of his predecessor in all the qualifications that form the mental gauge by which we

may measure the intellectual and social relations that an individual bears to the community in which he lives.

We may freely admit the statement of the socialist that "the rich are growing richer," but it does not follow as a corollary that the poor are growing poorer. It is true that capital through combination has vastly increased its power to organize and prosecute industrial pursuits on a scale of unprecedented magnitude, and that, especially as the result of energetic exploitation of new inventions, large rewards have been gained by bold investors; but I claim that, in the aggregate, labor has gained a much larger share of these benefits without incurring any of the risks.

The rich pecuniary rewards which have been reaped by Sir Henry Bessemer, and by other manufacturers who were far-seeing and courageous enough to develop his cheap process of steel-making and its later modifications, make but a small item when compared to the countless millions paid to labor during the past thirty years as the result of the development of these discoveries through the aid of capital. The Bessemer process of steel-making did more than this for labor: it sounded the death knell of the most exhausting form of toil known to man, that *inferno* of labor, the puddling of boiling iron by human hands. Many similar illustrations could be given.

I claim that modern mechanical inventions have in all cases proved to be distinctively beneficial to the wage-earner: he is, through their aid, better housed, better fed, better clothed, better educated, has more numerous and better amusements, and is thus approaching more nearly to the condition of the employer. Indeed, the wage-earner to-day enjoys many advantages of civilization which were unknown to employers of former generations.

Herr Liebknecht, the leader of the Social Democrats in the Reichstag, presented to American readers The Programme of German Socialism in The Forum. I carefully studied his paper with the view of discovering, if possible, some rational explanation of the problem, "How is socialism going to benefit the condition of the working class in America?" but the question remains unanswered. It is true that figures are given showing the marvelous growth of social democracy in the German Empire since 1890, and the author glories in the title which he gives to German Social-Democracy, viz., "the party of the discontented"; he also perceives signs of "an impending social crisis"; he likens the struggle between socialism and the Government to the fable of the Goblin and the Peasant; but the introduction of such a movement into this country could, I think, be more appropriately likened to the fable of the killing of the goose that laid the golden egg.

The recent presence in this country of more than one agitator from abroad, and the industrious dissemination of socialistic lit-

erature among our workingmen with the evident intention of making proselytes, thereby disturbing the peace of mind of the operative, endangering the stability of our industrial laws, and tending to nullify the gain which has come to wage-earners in America through the comparative freedom from such disturbing elements, is a subject of concern to all friends of the workingmen.

In Germany the literature of socialism has not confined itself to agitation of labor questions, but has catered to the demand for popular reading and also for popular education. In this way it gained the confidence of the people. "It has abused this confidence by giving distorted views of the writings of many of the greatest thinkers and educators"; it has used popular education as a club with which to beat into ignorant skulls socialistic propaganda. The enormous socialistic vote in Germany proves the success of the force used. Such a force, if properly applied, would be immensely beneficial to humanity; but improperly used, socialism is, as Herbert Spencer declares, "the greatest calamity that has ever befallen the human race."

The most intelligible exposition of modern German socialism may be found in a little book entitled Three Months in a Workshop, written by a student, Paul Göhre. In a prefatory note to the English translation, by Prof. Richard T. Ely, it appears that "Mr. Göhre, perplexed by conflicting theories and reports touching the lot of the German wage-earners, determines to become a wage-earner himself, and, donning the garb of a workman, finds employment in a large establishment for the manufacture of machine tools in Saxony; he mingles for three months with his fellows, who never supposed him to be anything else than a wage-earner; he shares their life, participates in their amusements, attends their political meetings, and then tells what he has seen with that simplicity which is itself literary art of a high order. The narrative is plain, straightforward, truthful."

The book is more than this: it is a practical view of a subject which has been clouded in mists. The writer has shown himself a keen observer, a disinterested and enthusiastic investigator, having nerve to enter the factory on the lowest rung of the ladder and to live and toil with the humblest employees, for the definite purpose of grasping the bottom facts of socialism as it is comprehended by the workingmen themselves, not as presented to the world by the leaders in the movement, many of whom do not really belong to the class they assume to represent. That Mr. Göhre should have succeeded, under these heroic conditions, in showing in his little book a clearer insight into the labor question and social democracy in Germany than can be found in many more elaborate treatises, is not altogether surprising. In the

chapters Work in the Factory, and The Material Condition of my Fellow-Workmen, the American student and operative will recognize abuses still existing in Germany which our more progressive establishments have eliminated. The contrast also in rates of wages and quality of living with wage-earners in America will excite sympathy, but will also weld the American more firmly to the belief that the condition of the wage-earner in this country is a happy and fortunate one by comparison; that its stability must not be jeopardized by countenancing socialistic agitation.*

In the chapters on Political Tendencies of my Fellow-Workmen and Social Democracy the student of industrial sociology will find much valuable information. In the chapters on Moral Conditions, and Education and Religion, ethical questions are plainly discussed. The final chapter, on Results and Demands, will interest all readers. It is shown that the labor question is not merely a wage question with the vast majority of the laboring class. It is only one factor in the movement—perhaps the most tangible, but not the most important or determinative one. "There is an ardent longing on the part of the whole class of factory labor for more respect and recognition, for greater actual and social equality in addition to the formal and political equality which is theirs already. . . . It is the irresistible impulse to a larger intellectual freedom, the craving for the benefits of knowledge and education, and for a fuller understanding of those high and lofty problems of the human soul which, despite the universal pursuit of wealth and externals, rise up before humanity today, new riddles in new forms. All this, rough, discordant, full

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* On entering the shops, Mr. Göhre received twenty *pfennige* (4·8 cents) per hour. Compulsory deductions were made for assessments for sick-benefits, insurance, fines for lateness or carelessness, etc.

Men working at the vise earned fifteen to twenty-one marks ($3.60 to $5.04) per week; their foremen, $5.28 to $6.72; drillers working on time, $3.60 to $4.56. "Piece workers" made considerably more. A specially skilled workman "would receive as much as forty marks ($9.60) per week." It thus appears that the highest wage of the most skilled operative slightly exceeds the lowest wage for unskilled labor in this country. The home life of the men was shown to be on a plane far below that of the average wage-earner in America.

Some suggestive and important information is to be gathered from a book just issued by the British Board of Trade, giving the statistics of wages paid for manual labor in Great Britain. From this it seems that the average earned by men is $6.03 a week; by women, $3.08; by boys, $2.24; and by girls, $1.56. These are the averages of the wages of 816,106 persons. In Scotland the rates are lower than in England by ten and in Ireland by some twenty per cent. The best-paid trade is that of builders, and then, in order, distillers, brewers, metal workers, engineers, sawmill workers, coach builders, and printers. Railroad men average five dollars a week. The chances of earning ten dollars a week are not common. Thirty-seven per cent of the printers, thirty-three per cent of the tinplate workers, thirteen per cent of the shipbuilders, eleven per cent of copper and brass workers, and ten per cent of coopers attain that amount. On the whole, the report indicates that wages in all British trades are on the increase, but at a very slow rate of progress.

of anomalies and extravagancies, yet plainly visible to the observant eye, stamps the beginning of the labor movement in Germany."

If confined to such lofty aims, the mission of socialism would be worthy of, and would command the sympathy and hearty cooperation of all enlightened people; but Mr. Göhre shows that it is necessary first to unmask the hypocrisy of social-democratic literature, to oppose the true to the false, the impartial to the partisan; he tells us that "German Social Democracy is to-day not merely a political party, not merely the promoter of a new system of economics, or even both of these and nothing more; it is also the embodiment of a philosophy, a logical, anti-Christian, materialistic conception of the universe. Upon this materialistic system it founds its economic and political system. This principle, the caricature of a so-called science, worshiped by its followers, is the corner stone of the party, gives it authority and ideals, and exercises the most fatal and lasting influence, not so much on the social and political tendencies as on the intellectual and ethical character of the whole German laboring class." This new gospel of socialism ran like wildfire among the hundreds of thousands of German workingmen. Herr Liebknecht tells us that "nearly two millions of men voted for the socialistic programme on the 15th of June, 1893, to whom must be added nearly a million of voteless young men between the ages of twenty and twenty-five years."

The spread of socialism in Germany has now reached the degree which is popularly termed with us a "craze." Its earliest converts became its new prophets, its inspired preachers; from inner conviction they gave their whole strength, their utmost capacity, to the cause. "Wherever two or three met together men set forth and discussed the thoughts they had imbibed from one book or half a dozen books of the new literature; sometimes fairly grasped, sometimes only half comprehended and more than half forgotten, but always brought afresh to their minds by the articles in their social-democratic paper. . . . The effect of this agitation was the one desired. Under its pressure all the old youthful training of the workman gave way and is still giving way in every individual who brings such training with him to a factory where the spirit of social democracy prevails."

If, now, we cull out these true and noble yearnings of the workingmen, discarding the sophistries of their self-elected leaders, we find that their aims are those which have already been largely attained by the wage-earning class in America through education; and while we may reasonably sympathize with the German "party of the discontented," we have nothing to gain by the dissemination of their socialistic literature, though they have much to learn from us.

In England the socialistic movement presents a different phase of development; there are fewer factions or cliques of socialists, and the tendency toward anarchism, while not so rabid as among the most radical wing of the party in Germany, is apparently even more generally diffused. Some of the recent socialistic literature published in England has a decided flavor of anarchism, at least in so far as it preaches the overthrow of laws by which land is held in private ownership; the private or corporate ownership of all kinds of property, factories, railroads, telegraphs, etc.; and evidences are not lacking of widespread discontent and unrest among the industrial population, which devours such literature with avidity. It is reported that a million copies of a single book of this character have recently been sold to workingmen in England.

The latest cabled reports indicate that a reaction in labor sentiment has set in in England. There was recently a "Free Labor Congress" in session at Newcastle. The president's opening address is reported to have been "a vigorous attack on trades unions, which, he declared, were manipulated by self-seekers, whose tyranny disgraced the cause of labor." His association, he said, had already formed "boards of conciliation" at many important centers. These boards were formed of equal numbers of masters and operatives, and were all working in perfect harmony. An editorial writer, commenting upon this cablegram, says: "The revolt from trades unions was not unexpected. It was bound to come as soon as the more intelligent workmen perceived that they could no longer own themselves, but were virtually made slaves of the lazy and inefficient members of the organization. It is singular that this should have been perceived first in England instead of in America." This writer is evidently not well posted in the history of the rise and fall of several labor unions in this country, which a few years ago counted their members by thousands where they now number units. Compared with a period of four or five years ago the majority of the unions have sunk into a condition of "innocuous desuetude," controlled by cranks.

Labor unions, however, should not all be classed under one category, for some of these are beneficial organizations, with high motives, sound constitutions, and, above all, wise leaders. Such organizations are opposed to violence and disorder, encourage harmony and arbitration, and are mutually beneficial and helpful to employer and employee; they are aiding to discourage the spread of anarchism and socialism in this country.

Socialistic theories are inimical to American ideas and principles, for the humblest workman is a free citizen, to whom a pathway is opened to the highest positions of honor and wealth. Many of our foremost men have risen from lowest origin, and

have no cause to be ashamed thereof. Socialism can offer no commensurate advantages; its tendency is not to raise the masses to a higher plane, but to reduce the competent to the level of the incompetent. The world is always crowded with incompetent operatives, while there is at the same time an unsatisfied demand for the absolutely competent.

In daily friendly intercourse with workingmen, extending over a period of twenty years, I have found a prevalent idea in many minds that employers of labor are, as a class, jealous of the material advancement of wage-earners beyond a certain point; that a maximum wage is soon reached beyond which they can not hope to pass, and that extra effort on their part would result merely in an increase of tasks without a corresponding increase of pay. This impression is more generally inculcated in the minds of operatives than employers realize, and it operates to their mutual disadvantage. Modern "piece-work" systems of pay have been devised (and are now generally practiced) with a view of stimulating workmen to produce the greatest output and largest percentage of perfect work; but these elaborate systems are to a certain extent rendered inoperative by reason of the suspicion mentioned. That there may have been, and may still be, some ground for such impressions I do not dispute, but I do believe that a more enlightened view of the mutual relations existing between employer and employee is gradually permeating the industrial world.

The great development of mechanical invention has not only increased the demand for skilled labor by increasing the output and opening constantly new fields of labor, but it has increased tenfold, and in some instances one hundredfold, the possible product of labor *per capita*. This is the reason why the American employer, paying the highest wages in the world, is nevertheless able to compete in the markets of Europe with so-called "pauper labor" in many manufactured articles.*

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* Mr. Mulhall, the English statistician, has recently published some tables relating to the producing power of the different nations of the earth. They show an enormous increase during the latter half of the century of the productive power of the people of this country, and they prove, moreover, that no other nations possess equal producing power *per caput*. By the figures which he has tabulated Mr. Mulhall shows that from 1820 to 1890 the "foot-ton" power of the United States increased from 4,292,000,000 of foot tons daily to 129,306,000,000 foot tons. A foot ton is a method that statisticians have of measuring the producing powers of a country. It signifies the ability of a man to accomplish with ordinary exertion in ten hours an amount of work equal to raising 300 tons one foot high. In 1820 the forces at the command of the Americans were equal to 446 foot tons of power *per caput* of the population. By 1890 the productive forces had increased to 1,940 foot tons *per caput*. These forces are now busily engaged in developing the resources of the country, in cultivating the soil, working the mines, operating the industries, carrying on the commerce, or in looking after the development of the mental powers and the enlightenment

It has been proved by actual experiment on a large scale in certain sections of this country that ignorant foreign pauper labor in manufacturing industries is ultimately the most costly, and the aim of enlightened employers to-day is not to obtain the cheapest labor but the most intelligent service. The true policy of the workingman is, therefore, not agitation but education.*

The organization through the aid of capital of large industrial operations, superseding former small independent industries, is a frequent source of lamentation on the part of well-meaning philanthropists and others, on the theory that the small merchant has been injured thereby. This is probably true in isolated instances, but the evidence that the wage-earner (the subject of our discussion) has been benefited by improved regulations, superior factory buildings, and amelioration of exhausting toil, under modern methods, is overwhelming.

Moreover, the employment of large capital and improved machinery has enormously increased production and decreased cost to the consumer. Wages are higher and cost of living is lower than formerly. The average wage-earner in America lives to-day in a manner quite superior to the small manufacturer of former days. The large factories employ armies of skilled operatives many of whom would be incompetent to conduct even small industries successfully. They are reasonably insured of a fixed income, and are often enabled, by saving a portion of their wages, to become small capitalists themselves. Capital is, after all, nothing more than the aggregate savings of labor. The great financial operations are conducted by the aid of these savings of the masses, otherwise the thrifty workingman could receive no interest on his deposit in the savings bank. The individual millionaire is a much less important factor in the world's work than the socialistic agitator would have us believe.

The "good old times" are hallowed in our recollections and in our traditions, but when subjected to critical comparison with the improved civilization of modern times, we find, I think, that the

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of the people, whereby their producing powers may be still further increased. Next to America in the scale comes Great Britain, the producing power of which is 1,470 foot tons to the inhabitant daily. Germany's forces amount to 902 foot tons for each person daily, those of France to 910 foot tons, those of Spain to 590 foot tons, those of Austria to 560 foot tons, and those of Italy to 380 foot tons.

* Thomas Carlyle, in his essay on Labor, said: "The latest gospel in the world is, Know thy work and do it; . . . for labor is life; from the inmost heart of the worker rises this God-given force. . . . Knowledge, that will hold good in working, cleave thou to that, for Nature herself accredits that, says 'Yea' to that. Properly thou hast no other knowledge but what thou hast got by working; the rest is all a hypothesis of knowledge—a thing to be argued of in schools, a thing floating in the clouds, in endless logic vortices, 'till we try it and fix it.'"

masses have gained immeasurably in all the comforts and conveniences of life, in social position, in political power, in freedom from care, in health and happiness.

The coming conflict between proletariat and plutocrat is a favorite theme with socialistic writers. According to these, wealth is *per se* criminal, and its chief employment the oppression of the poor. I claim that modern experience proves the antithesis of this statement, which selects exceptional instances of financial crimes and attempts to use these as a blanket with which to smother all the good deeds and grand undertakings in which capital is ever engaging. Patriotic sentiment also protests against such statements. The aid of capital has been the means within little more than a century of raising the United States of America from the condition of an insignificant agricultural colony, which was not permitted under monarchical rule to manufacture the simplest articles for home consumption, into the greatest workshop of the world, and has placed it in the front rank of wealth and power among nations.*

Capital has stimulated the inventive faculty of the people and thereby aided the operative in many instances to emerge from the condition of the laborer into that of the capitalist. Very many, perhaps a majority of employers in this country, are men who have risen from the ranks of labor.

The reckless denunciation of wealth by foreign socialistic agitators is the chief danger confronting the industrial class in America to-day, since it tends to retard investment of capital in industrial enterprises, and thus to restrict the employment of labor. It is far easier for the agitator to "kill the goose that lays the golden egg" than it is for the mischief-maker to turn his hand to honest labor. The free soil of America is not adapted to the growth of such noxious weeds, and the sooner such pernicious doctrines are eradicated the sooner will our industrial population reap the rewards to be gained in the returning prosperity for which it has so long and patiently waited.

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* The first spinning jenny ever seen in America was secretly imported from England and exhibited in Philadelphia in 1775. In 1774 the British Parliament enacted stringent laws prohibiting the exportation to America of textile machinery. It was provided (by 21 George III, chap. 37) that "any person who packed or put on board, or caused to be brought to any place in order to be put on any vessel for exportation, any machine, engine, tool, press, paper, utensil, or silk manufacture of the kingdom, or goods wherein wool, cotton, linen, or silk are used, or any model or plan of such machinery, tool, engine, press, utensil, or implement, should forfeit every such machine, etc., and all goods packed therewith, and £200, and suffer imprisonment for one year." In 1782 a law was enacted which prohibited, under penalty of £500, the exportation or attempt to export "blocks, plates, engines, tools, or utensils used in, or which are proper for, the preparing or finishing of calico, muslin, etc." The same act prohibited transportation of tools employed in iron and steel manufactures.—*United States Tenth Census, vol. ii, p. 537.*

APPENDIX.

THE COST AND DANGER OF STRIKES.—Few persons are aware of the enormous annual loss of wages due to strikes. Startling figures are furnished by the Labor Bureau at Washington in a recent publication covering the period from 1881 to 1894 inclusive.

It appears that no less than 3,714,406 persons were thrown out of employment, suffering a loss in wages of $163,807,866. Fifty-five and a half per cent of the strikes failed entirely ; thirty-two per cent are classed as successful, and twelve and a half per cent as doubtful or partly successful. Labor organizations contributed $10,914,406 to assist strikers.

The promoters of strikes argue to their comrades that unsuccessful efforts are nevertheless ultimately beneficial ; but study of the subject has led me to take the opposite view, viz., that all strikes of skilled workmen are, in the end, harmful to the participants. No one single cause has done more, in my opinion, to hasten the introduction of entirely automatic machinery in operations where a certain degree of skilled labor was considered indispensable, than strikes on the part of such skilled employees. Numerous instances might be recalled where large manufacturers have, on account of strikes, cheerfully expended immense sums of money in perfecting automatic machinery, not primarily to effect economy in wages, but as an insurance against future danger from such causes.

A notable instance of this nature occurred a few years ago at one of the largest iron and steel works in the world. In a certain department specially skilled men were able to make wages which now seem incredible; they were, however, paid a percentage upon the tonnage, and, owing to enormous output, the profits of these operatives exceeded in some years that of many successful manufacturers having large capital at stake. These men considered themselves indispensable, and struck, not for higher wages or shorter hours but at the dictation of outsiders. When work was resumed they found their occupation gone forever: automatic machinery had supplanted the former skilled labor.

I do not believe that any employee (I am one myself) is indispensable, and many highly skilled and otherwise valuable operatives have, unfortunately for themselves, failed to appreciate this fact until too late.

The danger I have indicated regarding the effect upon skilled labor of strikes does not appear to have presented itself to the minds of the workingmen, and if their leaders have perceived it they have concealed it. I regard the strike as a barbaric weapon of attack, resembling somewhat the boomerang, which, we are told, frequently returns and injures its projector.

Another element of danger to the workingman which usually accompanies a strike is the license which it affords to the irresponsible and lawless element of society to commit depredations, endangering the lives and property of innocent persons, and sometimes compelling the use of armed force for its suppression. The strikers, though innocent of these overt acts, are injured thereby, and the suspicion lurking in many minds is not without foundation, that some leaders of strikes, while openly exhorting their followers to preserve the peace, secretly count upon this outside aid ; and if they do not, they are strangely blind to the result of past experience.

The Eight-hour Agitation.—This is the fundamental principle or philosophy of the trade-union movement in this country, and in 1888 "the American Federation of Labor," numerically one of the strongest of the unions, voted to unite with the "Eight-hour League," and thenceforth to concentrate all effort on the struggle for eight hours. Their programme was then to take charge of one trade at a time. Thus, in 1890, the gage of battle fell to the lot of the carpenters, who accordingly struck, under orders, for an eight-hour day on May 1st, and won temporary victories in one hundred and thirty-seven cities. Plans were laid for the miners to strike, on May 1, 1891, for eight hours, but the conditions were not then favorable, and although these plans have since been in abeyance owing to depressed conditions of trade, they have not been abandoned, and I have reason to believe that employers in almost all trades will be called upon to meet this question in the not very distant future.

The argument of the eight-hour philosophers is that, by restricting the hours of work, more laborers must be employed and the idle surplus provided for; I consider that this is specious reasoning. The overflowing stream of immigration from European countries, attracted to America by comparatively high wages, suffices even now to produce a permanent flood, at least in the fields of unskilled labor. If to this we add a still more powerful attraction of eight hours forming a legal working day, the tidal wave flowing from all the less favored countries in the world would swamp our native industrial population and induce a condition which would be far less favorable to them than that which now obtains.*

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* I am able to substantiate these views by figures bearing upon the subject. The official statistician of Paris, M. Berthelot, gives the proportion of foreigners in that city as 7·5 per cent; these are chiefly wealthy persons who distribute a portion of their funds among the tradespeople. London and Vienna have each 2·2 per cent. Berlin has 1·1 per cent of foreigners, also mainly persons of wealth.

The foreigners residing in American cities are chiefly poor immigrants who compete with the native working class for wages, and are accustomed and content to live in comparative squalor. The percentages of "foreign born" to total population in five principal American cities are as follows: Philadelphia, 25·74 per cent; Boston, 35·27 per cent; New York, 42·23 per cent; Chicago, 40·98 per cent; Milwaukee, 38·92 per cent. *More than thirty per cent of the foreign-born males, twenty-one years of age and over, in the five cities named, are aliens.* The percentages of "persons of foreign parentage" to total population in these cities are as follows: Philadelphia, 56·58 per cent; Boston, 67·96 per cent; Chicago, 77·90 per cent; New York, 80·46 per cent; Milwaukee, 86·36 per cent. This information was courteously furnished by the Chief of Census Division, Department of the Interior, Washington, March 12, 1896.

More rigid enforcement of contract-labor laws has decreased importation of foreign labor under direct or written contract, but there is ample evidence that Italian labor purveyors still influence such immigration. Immigrant inspectors Birmingham and Hinkle reported (under date of January 11, 1895) to the Secretary of the Immigration Investigation Committee, among other facts, as follows: "Mr. Desabadia (an Italian padrone of New York) informed us that he was regularly engaged in supplying Italian laborers in any numbers to contractors or others desiring labor done; that he was prepared now to furnish from two to six hundred men (Italians) for work of any nature; that he could furnish stonemasons, carpenters, or men of almost any of the building operations."

The equivalent of the padrone system is not confined to Italians. Poles, Hungarians, Greeks, and other foreigners, temporarily camping in this country, are forwarded "on call"

The eight-hour party has succeeded through political influence in making eight hours a legal working day in governmental employment, and largely also in municipal contracts, and violators of the law have been rigorously prosecuted. A remarkable case occurred in Buffalo,* which worked great hardship upon a citizen, and led to the decision of Justice White, of the Superior Court at Buffalo, declaring the eight-hour law unconstitutional, based upon the clause of the Constitution which provides that no person "shall be deprived of life, liberty, or property without due process of the law." That provision of the Constitution has been construed to mean that the rights and privileges of a citizen to make contracts relat-

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wherever large operations are in progress, crowding out American labor by accepting lower wages. In Texas and other border States invasions of Mexicans occur at regular intervals, especially at sheep-shearing time; these people contribute nothing to the wealth of the country, and patronize the railways by walking home on the ties!

An investigation made by the Senate Committee on Immigration in 1893 (Senator Hill chairman) developed the startling fact that Italian bankers remitted to Italy from New York city alone twenty-five to thirty millions of dollars a year, largely savings of "Dago" laborers, and a marked increase in wealth in certain sections of Italy has been traced directly to money earned in the United States by these "birds of passage." Italians who have become domiciled here for a few years are beginning to make incursions into skilled labor fields where they were unknown formerly, and where even such a suggestion would have been ridiculed. In the shoe trade, for example, it is said that large numbers of Italians have been substituted for American workmen who went out on strike some time ago.

The facts stated in these various footnotes have been gathered at different times during several years by the writer from a variety of independent sources, and it is only when placed in juxtaposition that their true significance becomes apparent. These illustrations are but a few samples of facts at hand that are too numerous to mention, and they present practical problems for legislators and workers of far more importance than any theoretical discussions.

* "Henry J. Warren, Superintendent of the Barber Asphalt Company, was convicted by a police court in Buffalo of a misdemeanor for a violation of this (eight-hour) section of the Buffalo charter, and punished by imprisonment. From his conviction he appealed to the Court of Sessions and to the General Term of the Supreme Court, where the conviction was affirmed, the courts holding the act constitutional and the conviction valid. As Warren could not by law appeal to the Court of Appeals in that case, he sued out a writ of *habeas corpus* in the Supreme Court, to test the questions affecting the validity of the conviction, and to inquire by what authority he was restrained of his liberty. This proceeding is a good illustration of the efficacy of the ancient writ of *habeas corpus*, for, although the Special and General Terms of the Supreme Court dismissed the writ, and again declared the prohibitory statute constitutional and the accused properly convicted; yet upon an appeal to the Court of Appeals the decisions of the lower courts were reversed, and the arrest, trial, and conviction declared without jurisdiction and void.

"After this long and tedious fight Warren was released, only to be arrested again for a violation of the eight-hour law, this time for employing an alien Italian laborer. He was indicted by the grand jury, and convicted in the Superior Court at Buffalo. His counsel contended that the act in question, so far as it seemed to prohibit the employment of alien laborers upon public works, was repugnant to the Federal and State Constitutions and to the treaty between the United States and Italy. Upon an appeal to the General Term of the Superior Court, the act, so far as relates to the employment of aliens, was declared unconstitutional, and Warren was discharged." (People *vs.* Warren, 77 Hun., 120; People *ex rel.* Warren *vs.* Sheriff, 144 N. Y., 225.)

ing to his business or property can not be interfered with by legislation. It has been declared by the courts that liberty, in its broad sense, as understood in this country, means the right not only of freedom from actual imprisonment, but the right of one to use his faculties in all lawful ways, to live and work where he will, to earn his livelihood in any lawful calling, and to pursue any lawful trade or vocation. All laws, therefore, which impair or trammel these rights, which limit one in his choice of a trade or profession, or confine him to work or live in a specified locality, or exclude him from his own house, or restrain his otherwise lawful movements, except where the public health or safety intervenes, are infringements upon his fundamental rights of liberty, which are under constitutional protection. (People *vs.* Warren, 34 N. Y. Supp. Superior Court, Buffalo, 942.)

The impossibility of regulating the rate and hours of labor by legislation unless in the exercise of the police power, or law of public health and safety, was recognized years ago by Chief-Justice Ruger, in McCarthy *vs.* Mayor, who said in reference to the original eight-hour law then under discussion:

"It is well to premise that this act was not intended to affect or regulate the rate of wages which should govern as between employer and employee. That subject is left by the act, as it always must remain, open, to be fixed by the agreement of the parties intending to enter into those relations. Experience has shown that legislation on the subject must always be futile and ineffectual, for the reason that it is controlled by the natural laws determining the value of labor and property, and which are as much beyond the power of statutes to affect as they are above the control of the wishes of the parties interested therein."

I do not mean to imply from the foregoing statements that I am opposed to shorter hours for labor; on the contrary, I believe that a shorter working day, wherever it is practicable, is beneficial alike to employee and employer; but under present conditions, it appears to me, after a careful survey of the field, that there are some prominent obstructions which must be removed before an eight-hour day can be universally adopted, or before the operatives who now work ten hours a day can reasonably hope for a general reduction to eight hours without a corresponding reduction of wages.

Wise men usually count the cost of any new undertaking before embarking in it, and a very simple calculation will show surprising figures as to the additional cost of manufacture should employers be called upon to pay the same wage for eight hours' that they now pay for ten hours' work. Let us assume that an establishment employs a thousand hands (there are factories having capacity for four or five times this number), a reduction of two hours per day per man would mean an aggregate of two thousand hours' reduction per day in the shop. Assuming the average wage to be ten cents an hour (this is much below the true average), the additional cost for this item alone would be two hundred dollars per day; while the loss from decreased output and increased fixed charges, rate of interest on plant, etc., per unit of product, would, I believe, extinguish any margin of profit obtained under present prices in any manufactured article where competition is keen. It is of course possible that in those occupations in which the output depends more upon manual dexterity than upon the mere tending of automatic machinery a decrease of hours may be partly offset by an increase of effort; but this would, I think, prove an exception, the effect of

which is discounted, in part at least, by the low figure selected to represent average wages.

It is apparent that a rearrangement of some kind would be necessary; is it not likely that this rearrangement would be found in a corresponding reduction of wages ?

Sympathizing as I do with all legitimate efforts of workingmen to better their condition, it appears to me that the aim of their organizations should be to secure a reduction in the hours of those workers who are compelled to submit to clearly excessive consecutive hours of attention to duty —conditions that are not only deleterious to the welfare and happiness of the laborer himself, but in some instances increasing the danger to life and limb of others whose interest and sympathy would be a powerful lever, if properly applied, to help to remove this incubus resting at present upon the boasted freedom of labor in this country.

If the views which I have here advanced shall have the effect of tending, on the one hand, to discourage unwise and impracticable schemes of some misguided wage-workers, and, on the other hand, to stimulate keener and more general interest on the part of employers of labor in the welfare of their operatives, and thus to foster a closer union between these two great interdependent elements of society, I shall feel that my efforts have been repaid. The nature of my occupation for the past fifteen years has perhaps afforded unusually favorable opportunities for viewing both sides of the sociological questions here discussed; it has certainly aroused keen personal interest in the subject and has stimulated study of these problems.

THE PHYSIOLOGY OF COLOR IN PLANTS.

By D. T. MACDOUGAL,

ASSISTANT PROFESSOR OF BOTANY IN THE UNIVERSITY OF MINNESOTA.

THAT the color exhibited by the roots, stems, leaves, and especially flowers and fruits of plants received serious attention at a very early date is well attested by ancient record. It was only in comparatively recent time, however, that the daring conjecture was hazarded that even such an abundant, widely distributed, and characteristic color as chlorophyll (leaf-green) subserved a purpose in the life-process of plants. Doubtless certain masses of marked color, or combination of pronounced tints, must have afforded a gratification to man's sense of beauty quite, early in his development. At the same time and earlier these colors were also used as a distinguishing mark in the selection of plants for food, and later they were taken to be indicative of the absence or presence of magical curative properties. The first-named feature is still valid, and forms the basis of the art of the gardener and florist to-day. The last-named aspect of plant colors received its greatest attention during the prevalence of the practices of the Grecian Rhizotomoi and Pharmakopoli, and later in the "doctrine of signatures." The doctrine of

signatures supposed that the color and form of plants indicated their relations, good or evil, to the human race, in reference to which they were especially created. This crude superstition attained greatest favor in the sixteenth century, and is still prevalent in obscure form among the lower classes in certain portions of Europe. The use of colors as a distinguishing mark between species, families, and groups began quite early in the history of attempts at classification, and still forms a minor character in modern systems. A wholly new point of view was that taken by Konrad Sprengel, in his history of the biological significance of color (Das entdeckte Geheimniss der Natur im Bau und Befruchtung der Blumen; Berlin, 1793). To Sprengel is due the idea that the colors of the secondary reproductive organs are a device for the attraction of insects, thus securing cross-fertilization. Investigations in many directions from this idea have revealed the fact that plants in a similar manner attract insects and other animals for many other purposes besides fertilization, and in some instances avoid such visitors, for various reasons connected with their development, in a similar manner. Such an amount of attention has been given to these ecologic color adaptations that the aggregate mass of the results recorded is nothing short of colossal. That these results are of immense value and importance goes without saying: yet, given such a thesis, it is impossible that the observations of both trained and amateur workers should not contain a large number of misinterpreted facts. The general principle has been drawn upon to furnish solutions to complicated or unusual arrangements of color, in a manner highly improbable and unscientific and in many instances verging upon the impossible and ridiculous. That it can not be assumed *a priori* that the colors exhibited by the flowers or any other organs of the plant are devices to attract and guide insect visitors is becoming more and more apparent. Timely attention has been called to the perversion of this principle by the writer of a recent article on floral biology (Willis, Science Progress, No. 21, 1895). That great care is necessary in the interpretation of areas of color in plants is emphasized by the fact that accumulating observations tend to show that a color sense is wholly lacking except among the higher insects, and that if the colors of flowers were fashioned to attract insect visitors the directive impulse must have been received at a very recent date—that is, since the acquisition of the color sense by insects. It is by no means the purpose of this article to discredit the great mass of well-confirmed facts concerning the uses of the colors as an adaptation to insect visitors, but chiefly to call attention to conclusions afforded by the last fifteen years of research upon the formation and physiological uses of color in plants. The functions sub-

served by many of the coloring substances besides chlorophyll are by no means secondary in distribution or importance to the individual plant to the exterior adaptations described above.

The principal coloring matters among the higher plants besides chlorophyll (leaf-green) are those which have been grouped under the terms erythrophyll, xanthophyll, and anthocyan. Of these substances the chemical and physical properties of chlorophyll are best known, although its exact composition is yet undetermined. Not only is our chemical knowledge of the non-green colors very vague, but it is thought that a great number of different substances are grouped under each of the above and other color terms. Thus, for instance, anthocyan is made to include the large number of substances to which are due the red, blue, violet,

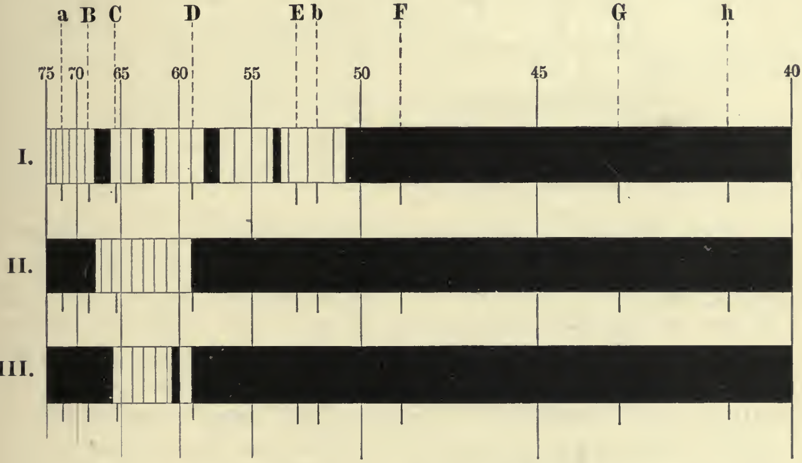

FIG. 1.—I. SPECTRUM OF CHLOROPHYLL SHOWING SEVEN ABSORPTION BANDS. The two in the red-yellow between B and D, and the three in the blue-violet, beyond F, are the most important and characteristic. The bands between D and E are most marked in the spectra of solutions which have been exposed to the air and light some time, and are believed to be due to disintegration products of chlorophyll.

II. SPECTRUM OF AMARANTH-RED. All the rays except those falling between B and D have been absorbed.

III. SPECTRUM OF AUTUMNAL COLOR OF LEAVES OF AMPELOPSIS. All the rays except a part of those falling between C and D have been absorbed.

and purple colors of such plants as the violet, beet, canna, rose and amaranth. Only so much is known of the formation of these color substances as to justify the assertion that many of them are produced as disintegration products of the glucosides and others from a mother substance—chromogen.

The coloring matters of plants may be in solution in the cell sap as in the beet and amaranth, in irregular solid masses in the sap or protoplasm, as in nasturtium (*Tropæolum*); or may be incorporated in the cell wall, as in logwood (*Hæmatoxylon*); or

dissolved in minute oil drops suspended in special masses of protoplasm, as is the case with chlorophyll.

Although this article is particularly concerned with the non-green colors of plants, yet it will be necessary to outline the function and adaptations of chlorophyll, to which these substances

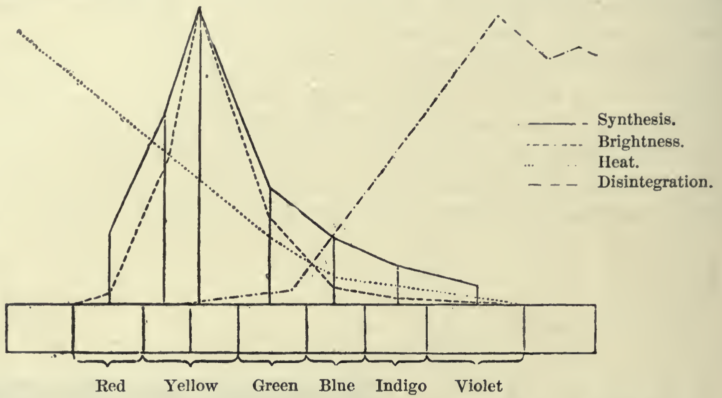

Fig. 2.—Curves showing Brightness and Synthetic, Thermal and Disintegrating Effects of the Regions of the Solar Spectrum.

bear a special relation. Chlorophyll is perhaps the most important coloring substance in the world, for upon this substance depends the characteristic activity of plants, the synthesis of complex compounds from carbon dioxide and water—a process upon which the existence of all living things is ultimately conditioned. Only in a very few unimportant forms devoid of chlorophyll can the synthesis of complex from simple compounds or from the elements be accomplished. The function of chlorophyll may only be comprehended when its chief physical properties are understood. These may be best illustrated if a solution of the substance is obtained by placing a gramme of chopped leaves of grass or geranium in a few cubic centimetres of strong alcohol for an hour. Such a solution will be of a bright, clear green color, and when the vessel containing it is held in such a manner that the sunlight is reflected from the surface of the liquid it will appear blood-red, due to its property of fluorescence, that of changing the wave length of the rays of light of the violet end of the spectrum in such manner as to make them coincide with those of the red end. It is by examination of light which has passed through a solution of chlorophyll, however, that the greatest insight into its physical properties may be gained. If such a ray of such light is passed through a prism and spread out on a screen, it may be seen that there are several large intervals or dark bands in the spectrum. The rays of light which would have occupied these spaces have been absorbed by the chlorophyll, and

converted into heat and other forms of energy. This energy is directly available to the protoplasm containing the chlorophyll, and by means of it the synthesis of complex substance may be accomplished. Moreover, the amount of synthesis accomplished by plants exposed to separate portions of the spectrum will be directly proportional to the amount of that portion which can be absorbed and converted into useful forms of energy. This is graphically illustrated in Fig. 2. The amount of synthesis is shown to be greatest in the red light between B and C, where the greatest absorption takes place. (See Fig. 1, I.)

Chlorophyll is a very complex and highly unstable substance, and during the absorption of light it is slowly broken down, but ordinarily it is rebuilt by the protoplasm as fast as it is decomposed. If, however, the chlorophyll and the leaf containing it are exposed to a light of such intensity that the chlorophyll is decomposed faster than it can be rebuilt, then damage must ensue, which if sufficiently extensive will result in the death of the entire leaf. The intensity of the light which induces a maximum of activity in any plant, and which it may receive without damage, is determined by its specific constitution. The intensity of light falling on a plant in an open plain during twenty-four hours ranges from almost total darkness to the blaze of the noonday sun, and varies almost momentarily. As an adjustment to this condition many plants are able to regulate the intensity of the light impinging on the chlorophyll-bearing masses of protoplasm by altering the position of the surfaces of the leaves. In others in which this movement is not possible—such, for example, as the leaflike duckweeds which float on the surface of the water—the intensity of the light received is regulated by alternations in the position and distance of the chlorophyll from the surface of the organ. (See Fig. 3.)

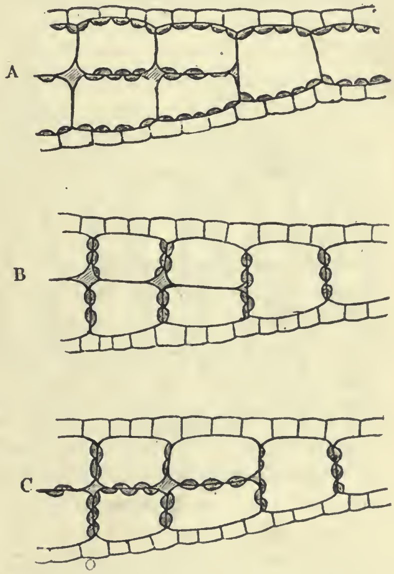

FIG. 3.—TRANSVERSE SECTIONS THROUGH THE FROND OF LEMNA TRISULCA (DUCKWEED), SHOWING DIFFERENT POSITIONS OF CHLOROPHYLL BODIES. A, position in diffuse light; B, in strong light striking the surface perpendicularly; C, in darkness.

In many plants growing in the bright glare of the sun a thickened cuticle or a heavy coat of hairs serves to protect the chloro-

phyll against the more intense action of the rays. It is also in this purpose of protection of the chlorophyll that many of the colors grouped under anthocyan find their chief function in the plant. In such instances the color is generally in solution in the sap of the layers of cells exterior to the chlorophyll, and light must pass through the coloring matter in order to reach the interior of the leaf. This may be seen by reference to Fig. 4, in which is shown a cross-section of a portion of a leaf of coleus.

That such layers of coloring matter do materially alter the light which passes through them may be demonstrated if the spectrum of light which has passed through a solution of them is examined in the manner described above. Water, instead of alcohol, is used as a solvent, however. If the color of the leaf of the amaranth is used, it will be found that nearly all the light has been absorbed except a portion between B and D (Fig. 1, II).

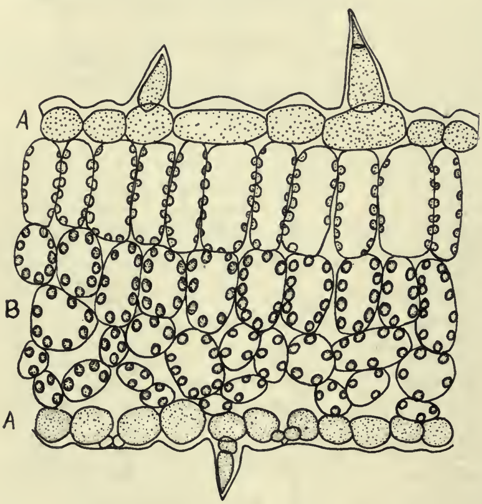

Fig. 4.—Cross-section of Leaf of Coleus. A, A, epidermal cells filled with reddish cell sap; B, cells containing chlorophyll bodies.

It may be seen that a large proportion of the light is absorbed by the anthocyan and converted into heat, and furthermore it is inclusive of the portion of the spectrum which exercises the most violent disintegrating effect on chlorophyll, as may be seen by reference to Fig. 2. The portion which promotes synthesis of food materials, on the other hand, is transmitted almost unchanged to the chlorophyll beneath. That the anthocyan does partially retard the disintegration of chlorophyll by light may be seen if two vessels containing solutions of chlorophyll are so arranged that the light which strikes on one of them shall first pass through a parallel-walled vessel containing water, and that which strikes the other through a similar vessel containing a solution of anthocyan. The chlorophyll in the first will soon become much more discolored than in the second, which has received light transmitted through anthocyan. The number of plants in which coloring substance is present in the cell sap or walls of the outer layers of leaves is extremely large, and em-

braces many well-known species, among which are the "foliage" plants of the gardener.

A very large category of plants have become adapted to living in the deep recesses of swamps and jungles, and in underbrush, where the direct rays of the sun never penetrate. These plants must carry on the synthesis of food material by the aid of the diffuse light which reaches them, and stand a little danger from its over-intensity. Still another group is found upon the higher slopes of mountains in regions of low air temperatures. In both instances these plants need all the energy they may be able to derive from the light which falls upon them. They are not able by means of their chlorophyll to absorb all this light, and some of it would ordinarily be transmitted through the leaf without advantage to the plant. As an adaptation to this condition, their leaves are provided with layers of coloring matter, which are placed near the lower surfaces in such manner that any light passing the chlorophyll will be absorbed and converted into heat. It is noticeable that plants growing in the swamps and on the mountain tops are not provided with layers of coloring matter, if the leaves are arranged in such manner that light passing the upper leaves will fall on those underneath. The heat-saving color screen is not needed in this instance, but is present most frequently in leaves which form a low, simple rosette, or which lie close to the ground. That the presence of anthocyan in flowers is also often for the purpose of converting light into heat seems well authenticated, from the number of plants which bear colorless petals or glumes at ordinary temperatures, yet develop color in these organs at lower temperatures at the beginning or end of the season, or at higher altitudes. That these bright colors in living plants do convert light rays into heat follows as a conclusion of the following experiment devised by Kny: Three similar glass vessels with parallel walls were filled with distilled water. In one vessel a number of green leaves of canna were placed, and in another such number as to offer the same amount of surface as those in the first, but which contain a large amount of anthocyan. The third vessel is left unchanged, and all are placed in sunlight of equal intensity. A certain rise in temperature naturally ensues in the water in the third vessel; a greater rise occurs in the first, showing that chlorophyll converts a portion of the light into heat, while the greatest increase takes place in the second, where, in addition to the action of the chlorophyll, the converting power of the anthocyan is exerted. The difference between the temperature of the vessels containing the green and red leaves often amounts to 4° C., which is due entirely to the action of the anthocyan.

It is often necessary for the plant to transport complex food

substances from one portion of the vegetative tract to another along conduits which lie near the surface. On such compounds, as well as on chlorophyll, the blue-violet rays (see Fig. 2) exercise a disintegrating effect. In quite a large number of plants, the lines of vessels in stalks, midribs, and petioles of leaves are shielded from the direct action of such rays by means of external layers or bands of anthocyan, of some shade of red or purple. It is possible in some instances to trace the line of the conducting vessels by the lines of color appearing near the surface. The direct connection between the food substances and the presence of the coloring matter is strongly indicated by the example detailed by Kerner, in which the pearly-white rhizome of *Dentaria* when taken from the soil and exposed to the light will become a deep violet in a few hours. Whether the connection is a direct one or not, it is also true that many young and rapidly growing shoots exhibit marked reddish or violet colors at a time when reserve food is being conveyed to them in greatest quantity, and when the thin, tender tissues are otherwise so translucent as to allow the sun's rays to strike through them in a manner calculated to work great damage in the complex compounds in the young leaves. When the leaves mature and are not so pervious to light, the colors may disappear. This is well illustrated by the behavior of the young leaves of rhubarb, cherry, and grape. Many instances of this character are known, as well as the fact that storage organs are often provided with coloring layers or shields, when partially exposed to the light under normal conditions. In plants with deciduous leaves, or the shoots which die down to the root stock each year, it is highly important that the material in the protoplasmic structures of the portion dying away should not be entirely lost, as it represents a large outlay of energy. As a matter of fact, in plants of this character the protoplasm, chlorophyll, and other nitrogenous substances are usually broken down and begin to be gradually withdrawn into the surviving portion of the plant about the time of the formation of the first stages of the absciss layer which finally cuts off the leaf stalk, or about the time the activity of the herbaceous shoot begins to slow down. The disintegration of the chlorophyll would leave the leaf almost colorless and translucent, and the sun's rays would strike directly through it, resulting in the total decomposition of the proteids and a consequent waste to the plant, but during the decomposition of the chlorophyll there occurs, as a result or accompaniment of the process, the formation of much brilliant coloring matter of various shades, to which are due the brilliant autumnal tints of deciduous leaves. These coloring matters sustain the same general relation to sunlight as the other colors described above. They generally absorb the entire violet

end of the spectrum, which, as has been pointed out, is the one which causes disintegration in the cells, as well as the lower red and infra-red rays. The spectrum of the autumnal red coloring of the leaves of the Virginia creeper (*Ampelopsis*) is shown in Fig. 1, III. It may be safely asserted that the above-described occurrences of coloring matter are undoubtedly marked factors in the physiology of a large number of plants, without reference to the manner in which such coloring screens and shields have arisen. It is also true, however, that a large number of plants contain coloring matters in the interior of organs or disposed in such other manner that they could sustain no possible relation either to light or to animals furnished with a color sense; still, many other occurrences of color are to be noted in which a physiological function is quite possible but is not proved. Among the latter is the color formation which ensues in evergreen leaves on the approach of a cold season, or in other leaves on the approach of a dry season. It must be admitted that in some instances physiologists have been led to conclusions concerning the use of colors quite as little justified as many of those reached by enthusiastic students of "adaptation to insect visitors." It is now somewhat generally admitted that color substances must very often be regarded as simply by-products in the chemical processes carried on by plants; a view which is undeniably valid of color masses in the interior of underground roots or tubers, or massive aërial organs, and also in a large number of instances in flowers. This latter application is further justified by the fact that some flower colors may change during the season without any relation to light conditions, insect visitors, or other ecologic factors. It is quite within the range of possibility that color masses in aërial organs bear an important modifying relation to the forms of irritability to radiant energy acquired by the plant.

As a summation of the foregoing, it may be stated that coloring matters stand in the following relations to the plants:

1. Chlorophyll converts light into energy by the aid of which protoplasm containing it is able to build up foods from carbon dioxide and water.

2. Non-green coloring substances serve as a screen between the chlorophyll and the too violent rays of the sun, at the same time converting the absorbed portion of the rays into useful heat.

3. Non-green coloring substances convert the light which has passed the chlorophyll bodies into useful heat.

4. Coloring substances absorb the blue-violet rays and prevent their disintegrating effect on nitrogenous compounds *in situ* or *in transit* in the interior of the plant.

5. Non-green coloring substances are in some instances simply by-products or waste matter from the physiological processes, and

in the present stage of development and under ordinary conditions are of no use to the plant containing them.

6. Colors serve as an attractive, guiding, or warning device for insects and other animals, more especially for the purpose of securing cross-fertilization and protection from injury.

THE POLITICAL RIGHTS AND DUTIES OF WOMEN.

By GEORGE F. TALBOT.

THE political enfranchisement of women is so prominent a topic of discussion among all people that live under representative governments that no apology seems required for a contribution to the debate. It does not, however, seem necessary to recapitulate the arguments for and against the concession of the ballot to women—as if that alone was the ultimate or principal part of their demand—or to sum up and formulate any judicial finding on the basis of these arguments.

It is not difficult to perceive that the usual ground might be gone over, the usual arguments for woman suffrage stated and conceded, without touching any of the vital issues involved in the proposed change. The fact is, that the right to vote, in giving reasons against which the conservative thinker is always at disadvantage—always obliged to be more or less illogical and inconsistent—is not what is really asked, but something beyond it very much more radical and questionable. Let us see if we can not by an appeal secure from discontented womanhood a frank acknowledgment of the real *ultimatum* of demand, the specific redress of what is deemed the actual grievance.

There are two alternatives which might be proposed to the Woman Suffrage Association, or whatever other body has a right to represent the political demands of women:

1. Let the ballot be given to all women of full age who are citizens, with the condition, however, in the article or act itself in which this right is given, that they shall not be eligible to any executive, legislative, or judicial office, under the national, State, or municipal governments, except certain clerical and subordinate offices now open to women under custom or law, such as postmaster, register of deeds, member of school committee, etc.

2. Let such women as petition for it be admitted to full citizenship, with the right to vote and hold office, on proving their qualifications before the courts to whom jurisdiction over such petitions may be assigned. The judge listens to the application and the proof offered, that the petitioner is fairly intelligent, that her moral character is irreproachable, and she has not and is not

liable to have any domestic duties or relations which will disenable her from performance of all the employments which citizenship might impose upon her. To require her to hold herself liable to be drafted as a soldier in case of invasion or rebellion might not seem in these times of peace necessary, but that she could and would perform the duties of any office to which she would be liable by the very franchise she had sought to obtain, without pleading any exemption or disability due to her permanent condition as woman, would seem a not unreasonable requirement. If, in the discretion of the judge, she should successfully pass this preliminary examination, let her be admitted to full citizenship, with the right to be an elector, and to be elected to office on the same terms with men; while women generally, who do not desire even to vote, who are appalled at the thought of competing for office, and for whom the duties of any office are utterly incompatible with their fidelity as wives and mothers, are left in the political status which they prefer.

It is not assuming too much to anticipate that both these alternative propositions, if submitted as a definite settlement of the woman question to those persons of both sexes who, on either side of the Atlantic, have by their zeal and devotion earned the right to be considered as the leaders of what is called the *woman movement,* would be listened to with disdainful satire and scorn. It is avowed by all these persons, who speak frankly, that women want the ballot in order that they may become candidates and officeholders, and so be able in the interest of their own sex to affect local, State, and national legislation. We may, therefore, lay on the table the specific question of giving the ballot to women—leave it unsettled—conceding that, if it were only that, the matter might be arranged to meet the wishes of the petitioners, and confine ourselves in this discussion to the rights and qualifications of women to be the administrators of political power, and the effect which the exercise by women of those political functions now performed exclusively by men would have upon the welfare and character of women generally.

I. To the complete performance of such political functions there is this serious natural impediment: four fifths of the women all the world over, between the ages of twenty and sixty, are occupied with paramount domestic obligations quite incompatible with that integrity of devotion to public duties which all the great executive, judicial, and legislative offices demand of those who fill them. Under this disability of Nature, or closely related to it, all the objections to the exercise of political functions by women may be classed, so that no other objection need be considered. If the mother of a family of young children should give to the office of President, Governor, judge, or sheriff that entire

devotion of energy, time, and thought which her official oath exacted of her, she would be obliged to do it at the expense of that assiduous care, watchfulness, and service which her wifely and maternal relations demand.

Let us consider contingencies quite likely to occur under a *régime* which divided fairly between men and women the responsibilities of civic and public life. Would a husband of the city where this is written, going early to and returning late from his business—say that of chief salesman in a large retail store, or a contractor engaged in erecting a block of buildings—enjoy the honor of his wife's election to the Legislature, if while she were shut up in committee rooms with men, or interviewed at her lodgings by lobbyists, or waiting to mingle her shrill voice in the *mêlée* of a general debate in the House, the measles or the scarlatina should break out in the forlorn group of his motherless children? The banker, who had been harassed all day by the intelligence of a financial crash that threatened his own fortunes and the funds of widows and orphans of whom he was the trustee, would have a still stronger claim on the public sympathy if, coming home at night for fellowship and cheerful words, and asking his eldest daughter where her mother was, he should be told: "Oh, you know she is out on the jury with eleven men on that dreadful murder case, and it is not thought they can come in before morning."

I know the answer to this objection generally made: Yes, there are many women, as there are also some men, whose health, whose business, whose domestic cares, render them averse to office and exempt them from its responsibility. The good sense of the voters may be trusted not to select such engaged persons as candidates; and if they should be selected the good sense of the candidate can be trusted to decline the office, and that will end it.

But is this answer quite satisfactory? It is a question of reconsidering and readjusting the occupations respectively of men and women, which all civilized and uncivilized peoples, without concert among themselves, have established and built into their social institutions. An arrangement of this permanence and universality may be considered an arrangement of Nature. Nature evidently regards as of supreme importance the perpetuation of the race, and imposes presumably, and at least potentially, upon all women a paramount duty in accomplishing this purpose. The political disability, whether extending actually to four fifths of womankind or potentially to all womankind, is one irrevocably connected with that very office and *raison d'être*, which called woman into existence. An objection to employment in public office good as against four fifths of the female sex ought to be good as to the whole sex, just as if it were a question of enlisting women as soldiers, or shipping them as seamen, or engaging

them as miners or engineers—a disability affecting the greater number would be likely to disenable the whole.

This is the situation. The great body of men—the men in the prime of their physical and mental powers—have no employments or duties imposed upon them by Nature incompatible with the strict performance of the obligations of public office. A man may be a punctual and industrious executive officer, a studious judge, a commanding general successfully conducting a campaign, and be no whit less a faithful and helpful husband, a wise and provident father. This very excellence in these purely private and domestic virtues, while it would add to his popularity, would never be thought of as impairing his efficiency as a public servant.

Now it happens that women during the same period of their physical and mental prime are by their ruling instincts and their dominant sentiments assigned to duties which leave neither time nor faculty for any absorbing and responsible public station. It might be invidious to say that the best women are in this category of disability; it must be said, however, that the women whom men think the best—at least the best to be wives and the mothers of their children—are not eligible to public office.

In this actual condition of things what will be the probable result of sharing with all women, by a sweeping enfranchisement, the privileges of all political offices? Only those will be likely to be proposed as candidates, or at least will consent to be candidates, who have no incompatible domestic duties—unmarried women, who have no pleasant homes, or fathers, brothers, or sons with whom they can live harmoniously, and all the forlorn class, who have failed to come into agreeable relations with other persons, or who have made shipwreck of their domestic ventures. I question whether the great body of virtuous and intelligent women, the mothers, wives, and sisters of the citizens, would be so well satisfied to be represented by such persons as by those citizens themselves. Our domestic experiences appoint and maintain relations between women and men far more tender and intimate than are possible between women and women, or betwen men and other men.

Nor is the contingent disability one to be lightly overlooked. There hangs over the fortunes of every woman, at least during the early periods of her career, the liability to the *grande passion* that so greatly affects human destiny and character. Every housekeeper knows how precarious is the engagement of her domestic servant. If you have secured an exceptionally excellent person in your kitchen, and have begun to look forward to months and years of wholesome cooking and economic administration, along comes the inopportune lover and carries off your prize. You think her an admirable assistant; so does he, and

under the spell of his superior attraction your vision of domestic quiet and order vanishes. The same fortune befalls female clerks in stores, in banks, and in public offices, and teachers in all schools, public and private. Almost invariably we lose our clerks, our teachers, when they become wives; almost invariably we do not lose our clerks and teachers when they become husbands, never except when they pass to a higher grade of service or to partnership or an independent business.

> Love rules the court, the camp, the grove,
> And men below and saints above.

Let us suppose that in this congressional district, under the *régime* of full woman suffrage, some brilliant, educated, and accomplished lady, whose eloquence on the stump in a political campaign had electrified thousands of listening voters, had been nominated and elected as representative to Congress. Among the auditors whom she had fascinated might not one every-way eligible man have been bold enough to make confession of a personal attachment before the eloquent pleadings of which this young Jeanne d'Arc of politics should find herself compelled to forego her ambition for public distinction, and take upon herself the humbler but sweeter duty of consecration to a single man? The same accident would befall everywhere. Only the intelligent and agreeable women would be popular, and only the popular women would be candidates and elected. To put them in office would of itself expose them everywhere to appropriation by men brought by the occasions of public business into the circle of their acquaintance. I dare not pursue further this dangerous argument.

Will the female suffragists consent to a *self-denying ordinance* that shall exclude from office? I apprehend not. That is the very thing they will not listen to with patience. They have avowed that what they demand is that women shall have an opportunity to try their hands at law-making and law-administering, with a view of bettering both. They wish to vote in order that they may vote for each other, and no way has been proposed or seems practicable of making women electors that will not also make them potentially the elected.

As soon as the naturalized Irishmen in Portland became an appreciable element of the voting population, they began to be put upon the electoral tickets for municipal and State offices by both parties. In Boston and in New York, where they compose a majority of the voters, they get the majority of candidacies for places under the city government. When by a heroic effort we lifted a million of ignorant and degraded slaves to the rank of citizens and electors, the immediate result was negro justices of

the peace, negro judges of the courts, negro members of Congress, and in more than one State negro Legislatures, which proceeded in a summary way to confiscate the property of the late masters by taxation, ostensibly expended in public works and largely wasted by private plunder. If the effect of raising to the grade of voters the whole mass of illiterate slaves was to give them the whole political control of several States, why will not this complete enfranchisement of women give them the political control in all the older States, where they will be in the numerical majority?

If it be urged that the great body of women in this country have no taste for politics and do not desire office, and that their domestic duties exempt them from the responsibility of office, the same conditions might have been urged in behalf of the freedmen. They knew nothing about politics, did not care for office, and were under the necessity of earning their living and getting for themselves and their children homes, fortunes, and the rudiments of education. In that very condition a few bright colored men, native and immigrant, and many cunning white men, *carpet-bag* adventurers, intervened as the freedmen's special friends and took the offices the negroes could not hold. May not a like experience follow woman suffrage? A few restless women, mostly those whose domestic relations are out of gear or who have failed in a congenial social career, will find themselves at leisure to pose as nominees and candidates to represent their whole sex, and they will remember, in the distribution of such offices as they do not aspire for, those cunning men who, believing that the millennium of woman's rights was coming, had made themselves prominent in advocating them.

II. What wrongs are there affecting society which the women's vote and the political power it gives will set right? What disability or oppression does woman suffer at the hands of man, which she must rise in her physical might to redress? Every other agitation for social or political reform now rife, or that has been rife in my day, has been able to justify itself by a flagrant abuse repugnant to the universal sentiments of mankind. Slavery, intemperance, the poverty and privations that have been caused by unjust distribution of the products of industry—all these are palpable evils that denunciation can not exaggerate nor eloquence winged by strong emotion overstate. But the woman's grievance against man in these modern times, in any civilized country, what is it? The moment you begin to sum it up, the moment you undertake to tabulate and itemize it, you provoke the indignation of all generous and intelligent women. The moment you attempt to inflate its emptiness with the breath of invective you have to deal with hysteric fancies rather than hard facts, or consciously to enact a *make-believe*.

I am careful to say that woman has no grievance *against man*, I do not say she has no grievance. In common with all sentient creatures she does complain of the hard conditions of universal existence—conditions which it has been the long, slow effort of what we call civilization to amend and improve. The special hardship of the lot appointed to her by Nature is, that the pains, burdens, and weary cares that parentage imposes upon each generation, in order to provide for the succession of the race, have been unequally and cruelly laden upon one of the sexes. Through the long uncivilized ages, before man had wrung from niggard Nature any material comforts, any security against impending death, any leisure for thought, culture, or enjoyment, the conditions of the male and female were more nearly balanced in what each was called to endure. If on the latter fell the pangs of childbirth, and the long vigils of nurture for the feeblest younglings among living creatures, on the former came the brunt of internecine battles with fierce brutes and fiercer fellow-men. Civilization increasing the leisure, lightening the toil of man, and relieving him in a large degree from the wars in which he was mutilated and slain, has not been able, in any appreciable degree, to redeem woman from the primitive sufferings by which she consecrated her motherhood; and so the unequal fortunes of the two branches of the human race have become under the improved fortunes of the race more pronounced.

Woman does not put this into her bill of grievances, nor with her instinctive delicacy is she likely to do so. Symptoms that indicate disease sometimes mislead as to the character and actual seat of the disease. What woman will not ask for herself the respect and sense of justice of man must award her, and that is the complete sovereignty over all those functions engaged in the perpetuation of the race, insured by physical structure itself to the females of the inferior orders of living creatures. Woman has earned by her sufferings, by the enormous surplus of her contribution of time and strength and feeling to the maintenance of the family life, the right to control it, to initiate by her selection and the promptings of her own sentiments and preferences all its permitted intimacies. But all this, so difficult to formulate, must be left out in a discussion of a distinct though related subject.

Leaving out, then, whatever offense a cruel Nature has committed against woman, let us see if men have fairly acquitted themselves of their natural obligations to her. Take the present legal status of woman. Since men began to make laws they have made them for women, and in what situation has their deliberate sense of justice left women before the law? One after the other they have obliterated from the statute book all laws that discriminated against women in respect to their personal rights, and

to the acquirement, possession, and disposal of their property—old laws that had their origin in the barbaric spirit that made woman the slave of man, and, it must be confessed, which found no little sanction in that dogma of our accredited Christianity, which taught, too plainly to be misunderstood, that woman was as much below man in the scale of being as man was below the angels, her paramount duty being to be subject to him. But all this barbarism, Christian and un-Christian, has been swept away, and that too not by woman's suffrage, actual or prospective, nor by woman's petition or any political agitation prompted by her, but by man's own sense of equity and right.

No, women are not an oppressed class, least so in the United States, in England, in any country whose people have inherited the Teutonic sentiment which in the ancient Germany described by Tacitus made women counselors and advisers in the affairs of war, government, and business, as well as in matters purely domestic. *Women are a privileged class.*

When I say, and say after much careful thought, that women in this country are *a privileged class,* I have not in my mind those courtesies and civilities that have become established customs in all good society. I do not mean the respect which prompts all well-bred men to lift their hats to every woman of their acquaintance whom they pass in the street, that starts to his feet even the aged citizen when a robust girl gets into a horse-car or a thronged public meeting, even when the occasion of it may be to affect an election in which only men are concerned. All these are graceful offices for men to render, pleasant attentions for women to receive; but they are trivial, and to magnify them into substantial equivalents for political disfranchisement is to add insult to injury.

Let me make a brief inventory of some of the more substantial immunities and exemptions which women as women possess and enjoy, which mitigate for them the stress and strain of life, which affect their character, happiness, and destiny, as the usages and etiquette of social intercourse do not and can not, which, if not a compensation for political privileges, and for that excess of burden that maternity bears in caring for the perpetuation of the race, is a generous attempt on the part of men to make for their mates and yoke-fellows an easier pathway through a rugged world. To most of these exemptions and immunities the sex have become so accustomed that they are rather regarded as a part of the order of Nature than as a conventionality dictated by a generous sentiment.

III. Women are exempted from the perils, wounds, and deaths incident to war.

When we study man through his long history, we are compelled to confess that he is a fighting animal. Whatever other

employments he has had on this planet, he has been largely occupied in killing his fellow-men. We have looked forward to an impending millennium of peace for the world. We Americans have assured ourselves that our country, strong in wealth and in numbers and in its remoteness from the great warring nations of Europe constantly watching each other in arms, would never be engaged in those wars that have decimated the human race through the boasted ages of civilization and Christianization. But what has befallen us? Our grandfathers passed through the long and wasting War of Independence; our fathers—a favored generation—had only the brief British and Mexican Wars; and, to compensate for this immunity, there fell upon us, the grandchildren, one of the most destructive and bloody wars of history. To this war the State in which I live contributed seventy-two thousand men—more than a tenth of its population, two thirds of its arms-bearing people. So far, even in this asylum of peace, war has made its demand on the human life of each successive generation.

The requisition which wars have made upon human life during the comparatively brief historic period is something frightful to contemplate, and this requisition has been decidedly upon one sex. It is true that myriads of women and children have perished in the massacres, famines, and pestilences that have supplemented battles and sieges; but it was nevertheless always the chief care of the fighters on both sides not to expose their women to these casualties, and the first condition of making men courageous soldiers is to assure them of the safety of wives and children.

To what is the exemption of women from military service due? The hasty answer may be, to their physical and mental unfitness. The physical strength of the average woman is perhaps twenty per cent less than that of the average man. This disparity could be readily adjusted by adapting the labor and discipline of the two classes of recruits to it. Make the regulation musket for the female regiments twenty per cent lighter than the standard, and so the personal baggage; and if twenty miles is a fair day's march for men soldiers, require of the women soldiers but fifteen miles. The nerves of women might more quickly than those of men succumb to the terror of shot and shell, or of a bayonet charge, but actual wounds and mutilations they would endure with more patience.

In the few instances of an exceptional custom preserved in history, natural disability had ceased to be a factor. There is a Greek legend of the Amazons, a race of women in Asia, so formidable as to terrorize all the early Grecian settlements, and to require such valorous heroes as Bellerophon and Hercules to subdue them. Travelers more trustworthy than Baron Munchausen

tell us of an African king, whose standing army is of women—a fierce and terrible array.

It is even possible that in this judgment an effect has been mistaken for a cause. Women have not been exempted from military service on account of their congenital delicacy, but their characteristic delicacy is the slow result of their exemption from this and other hardships submitted to by men.

Certain phenomena open to general observation warn us that it will not do to trust too implicitly the permanence of natural laws, and that physical structure and accompanying mental endowments may be greatly modified by continued unfavorable environments. Among certain orders—the bee, for example—sex itself may be determined by a continuous special regimen and diet, when the exigencies of the community require it. Among domestic animals the cow, especially honored for the service rendered to men by her maternal functions, has been exempted from the yoke of labor and maintained in an indolent isolation of respect nearly equal to that of the queen bee in the hive. The result has been such a differentiation in bulk and build as almost to declare a difference of species between herself and her congener of the other sex. Among horses, sheep, and swine, a substantial uniformity of regimen and discipline brings the two sexes into physical conditions with no appreciable differences in size, form, and strength. So, too, with the carnivora: a community of employment, of exposure, of activity in predaceous warfare, tends to bring size, shape, and color into a uniformity of type, while among other wild orders, like the stag, the greater bulk, the exaggeration, of the parts serviceable in combats is clearly due to continuous fighting assigned to the males alone.

To what, then, must the anthropologist attribute that custom, almost immemorial and universal, which savage and civilized men have concurred in establishing, of exempting women from the service of fighting? To that which will be found to be the spring and source of most of their customs and institutions—sentiment; a sentiment in man of mingled pity, respect, and affection—a sentiment, like most others of somewhat low origin, beginning, it may be, in selfishness and the promptings of instinct, but flowering out in its complete evolution into a noble and divine virtue.

Facts of our own national history illustrate, if they do not confirm, this judgment. Our civil war called out, as I have already said, two thirds of the whole arms-bearing population of one State, and probably the same proportion for all the North. It called out three thirds of the arms-bearing people of the South. The war ended simply because one section had, and the other had not, a reserve of one third to fall back upon. Probably no two

peoples ever entered into a strife so fiercely and so unanimously as did the rebels, men and women, to win their independence, and the loyalists, men and women, to save the Union. And yet, earnest as we were in the struggle, recruiting our armies by volunteers, by enlistments, and by conscriptions; putting into the field patriots and scholars, citizens and aliens, philanthropists, clergymen, and criminals, and finally thousands of negro slaves, so deeply is the sentiment grounded in the heart of all civilized and savage men that women must not be put into the actual peril of battle, that the North would have given up the Union and the South its independence rather than have called into the field a single company of arms-bearing women.

There is plausibility in the contention that the ballot and the rule that the minority must submit to the majority are nothing but a development of primitive war. War puts all questions to the arbitrament of strength, and in the actual trial non-combatants do not count. The ballot is the count of the potential fighters, and presupposes and discounts a virtual combat. The right to rule belonging to the superior strength, the array of the combatants declares which is the stronger.

All through the earlier periods of English history, when some ambitious or reforming chief wished to get an obnoxious law repealed, or to displace an odious minister, or to change a hated dynasty, instead of starting newspapers, holding public discussions, and canvassing the country for votes, he summoned his retainers and fellow-chieftains to arms, took the field, and began to lay siege to towns and strongholds. The Government turned out its army and its adherents and met the malcontents in battle. If it was strong enough to overcome them, the leaders were beheaded and their estates confiscated, while the defeated followers were punished and dispersed. If the rebels were victorious, a new order succeeded—a new ministry, a new national policy, perhaps a new dynasty. All the great changes in government in England were effected in just this way down to the middle of the last century. In Mexico and the South American republics, though they have written Constitutions and periodic elections, voting seems to be considered a slow method of redressing grievances; the actual working system is *pronunciamientos*—that is, armed revolts against the administration in power, and the real *battle*, not yet evolved into the modern *ballot*.

Now, when the two forces—the one for, the other against, the Government—stood confronting each other, what could be more sensible than to anticipate and discount the result of the fighting? "How many fighting men," asks the loyal general, summoning a conference, "have you on your side?" "Fifteen thousand," replies the rebel chief. "Then why fight it out? for I have but ten

thousand, and yours are the best armed." Instead of a battle, there is a count of the combatants and a settlement in favor of the numerically stronger. So a count of the fighting forces took the place of a trial at arms, and the appeal to the majority of men capable of becoming soldiers, and so able to enforce their will against the weaker minority, took the place of insurrection as a method of political agitation. This view may not justify, but it does account for, the exclusion from enumeration in the class that decide political issues of the whole class of non-combatants.

IV. The next great immunity which, in recognition of the offices they exercise in the social system, and having its origin in the same sentiment, women enjoy, is exemption from all kinds of labor dangerous to life or exposing to hardship and privation. Thousands of men among all civilized and some barbarous people pass their lives from childhood to old age on the ocean as seamen. Their *terra firma* is the sloping deck of ships staggering through the restless billows, the sport of fickle winds. They fare hard; their sleep is liable to rude interruption; their toil, though not constant, is liable to crises of exertion and danger. At the word of command, enforced by brutal blows, they climb the slippery ropes or icy spars at the risk of being shaken into the boiling waves or, with fractured skulls, upon the reeling deck. This employment, from which women are excused, is only slightly less fatal to life than that of the soldier, and the ingenuity of man has devised no means considerably to lessen its annual roll of premature and appalling deaths.

In the same category belong those occupations that take thousands of workingmen into our northern forests, where they pass three months of each year contending with frosts and snows, sleeping upon hemlock boughs in smoky camps, and maintaining an exceptional vigor expended in continuous labor by the abundance of their rude fare. A shorter interval of more dangerous labor succeeds this long exile in the forest, when the timber the winter's industry has gathered is driven to the place of manufacture and sale through wide lakes and over dangerous rapids.

All the hard, repulsive, life-wearing work under ground in coal, mineral, and metallic mines is generally assigned to men, and they alone are exposed to those perils which beset engineers, train-men, the handlers of explosives, and the tenders of machinery.

It is certainly apparent that man, as the stronger sex, has not made an ungenerous use of his strength in his assignments. Having, in the right of his strength, the opportunity to determine the customs of society, he has taken upon himself, and exempted his mate from, all those vocations that expose to prema-

ture death or to great physical suffering, as well as those which segregate men from the social enjoyments of home and doom them to long exile in cold, storm, and darkness.

V. The last privilege of the sex—for only the great, cardinal privileges of womanhood need be enumerated—is woman's virtual exemption from the care of earning her livelihood and that of her offspring. Here, as in what has been said heretofore, I have disregarded exceptional and abnormal instances, and traced industrial and social customs, as men following the promptings of their dominant sentiments have been able to establish them. I have taken, too—and this seems legitimate—my illustrations from the most advanced types of civilization, rather than from the inchoate manhood of the savage and barbaric epochs and conditions. I do not forget to have seen women tugging baskets of manure to their miserable fields, or buried under burdens of hay, in Switzerland; nor the Sunday I drove by women mixing mortar and carrying hods of bricks up shaking ladders in the elegant city of Vienna; nor how all-prevalent poverty has equalized the lot of the two sexes in Russia.*

No law of social completeness is to be drawn from such exceptional instances. It is only on those broad lines where the instinctive tendencies of the dominant sex have not been hindered in their complete development by conditions imposed by primitive barbarism or slavery that the natural growth of a social status is to be studied.

But even in our times and among the most advanced races there are many exceptions to the general assignment to men of the primal care for daily bread. Very many men, through accident, sickness, and mental or moral incapacity, get disabled in the struggle for life, and the burden they were appointed to carry falls unnaturally upon a wife, a sister, a daughter. Widows carry on successfully the farms which a dead husband had cleared. Sisters take places in stores, in schools, engage as copyists, and contribute to periodicals, and so bring to the family fund the stipend which a deceased father, a dissipated husband, or an invalid brother ought to have earned. The social organism gets mutilated and wounded, and these are Nature's efforts at

* "The women are more diligent than the men; and the hardest work is often turned over to them, as is generally the case where peasant properties prevail. They are only 'females of the male,' and have few womanly qualities. They toil at the same task as men in the fields, ride astride like them, often without saddles; and the mortality is excessive among the neglected children, who are carried out into the fields, where the babies lie the whole day with a bough over them, and covered with flies, while the poor mother is at work. Eight out of ten children are said to die before ten years old in rural Russia."—(From a Review of F. P. Verney's Rural Life in Russia, in the Nineteenth Century, of January, 1887.)

recuperation and supply. In the healthy normal society—such as man establishes wherever he can—the true order seems to be that "man must work and woman must weep"—unless a cheerful temperament shall convert her weeping into a song, while waiting on the weariness of her yoke-fellow with affection and the ministry of a lighter service.

How few men in all civilized countries are from youth to old age exempt from the absorbing, imperious, ever-recurring necessity of earning the daily sustenance of themselves, of their wives, of the children they have dared to summon into a world bristling with hard conditions—a responsibility that sobers so many lives, and issues so often in insanity, suicide, or crime! If a census-taker should visit any day the homes of the *well-to-do* people of this or any other Eastern or Western American city, how would he be likely to find the sexes—of course, with the exceptions of idle men and too hard-working women—respectively employed? The men rise in the morning—some it may be leisurely and late—and go to their shops, their stores, their offices, their out-of-doors employments, spending the whole day in absorbing labor, the fruit of which tells directly upon the family income. If this mode of life, which becomes habit and routine, is ever interrupted, it is by some errand of business to Washington, to some commercial city, to the West, and, for a favored few, a genuine vacation of relaxation for two weeks at the mountains or the seaside. The women, after the oversight of the female laborers who perform the tasks of cook and chambermaid, and needle-work largely of an ornamental kind, pass the day in reading the magazines, the current novels, in the amateur practice of music or some other fine art, and in making and receiving social calls.

The understanding that custom has established in New England is, that when there are boys and girls in any well-conditioned family, the boys shall pass directly from school into some employment for wages, that shall occupy every working day of their lives; and that the girls shall be at liberty to cultivate their tastes and enjoy the pleasures of refined society, and be maintained by the labor past, present, and future of their fathers, their husbands, their brothers, or their sons. This is an arrangement that the modern man, following his controlling sentiments, has voluntarily made, and one that he insists shall be maintained. Accident, calamity, very often incapacity or vice, make men fail in the accomplishment of their generous purpose, and throw upon women unnaturally and abnormally the sterner cares and toils of earning the common livelihood. Men are defeated sometimes in realizing the careers that seemed open to their ambition; but these are exceptional cases, and social laws and tendencies are not

to be studied in their irregular and unusual development, but in their normal evolution.

If a capable and ambitious girl declares that she will teach school, or solicit a clerkship, or literary work in a newspaper office, or open a store, it will be the father and brothers who will protest, and not the mother and sisters. The men of the family are apt to feel that it will compromise their respectability if they have a daughter of the house earning anything. Fathers of sons and daughters have been reported, who have said: "I shall leave what little property I have to my girls, who will need it; the boys can take care of themselves." Many persons are cognizant of the fact that among their circle of acquaintance are a few men, high-spirited, conscientious, alive to the demands of nobly living, who have denied themselves the solace of marriage because they belonged to families where there were unmarried sisters, and the home could not be respectably maintained if their personal income was used in supporting another household.

VI. Now, putting any just valuation upon these great exemptions which the majority of women enjoy, and which all women enjoy so far as the appointment of men as a whole can predetermine their lot, can it be for a moment claimed that the position of women is one of *oppression*, and not of *privilege?*

I do not wish to say that men and women ever made a formal compact that the latter should surrender to the former all their natural political rights, as a condition for enjoying these privileges which have been awarded to them. None of the established customs of society, not even the forms of political government, were made in this artificial way. They were not made at all, but grew spontaneously. Rousseau's doctrine of a social contract is less in vogue than it was in the political philosophy of our fathers. But what I do wish emphatically to say is that, bargain or no bargain, the weaker sex has not been taken advantage of, and that its immunities and privileges are a full equivalent for all the political rights of which it may have been deprived.

For all the last century, perhaps for all the next, the stress and activity of the world have been and will be directed toward the development of a more pronounced individualism. Everybody is in intense pursuit of his *rights.* Everybody passionately asks: What of the common goods of existence can I appropriate to my own personal advantage and enjoyment? While this passion rules, nothing is to be expected but revolution and revulsion, the tearing down of the existing social and political institutions. When shall begin that more noble, more religious inquisition, not for *rights,* but for *duties,* when it shall be asked: What can I do to render some equivalent for the boon of life? What of my *rights* and my *possessions* can I surrender and sacrifice for the general

good ? then will the era of social and political construction upon a grander order begin. Meantime, to the chorus of the citizen, the workingman, the serf, the slave, all accusing the old tyrannies of denied justice, is added the shrill note of "*insurgent*" womanhood—not universal womanhood, for universal womanhood, acquiescent and content in the spheres of service which her lot as wife and mother and other equally helpful relations to society give her, has not joined in the revolt.

The formula of the demand of "*insurgent*" womanhood is the ballot, but the ballot must be considered with all the power to make and administer the laws which it confers, with the probable changes in social customs it involves, and the new conditions it will present under which the struggle for life will go on.

I have assumed that the concession of the ballot, pure and simple, will not be satisfactory to those bodies that represent what is called the Woman's Cause. Senator Hoar, perhaps the most conspicuous man who has appeared as their champion, specially says: "I am quite willing to agree that no class of persons who are permitted to vote should be excluded as a class from holding office."

We may as well consider what changes in human society, and especially in the character and fortunes of woman, the new order of things sought to be inaugurated will be likely to bring about.

Immediately, and in one generation, not very many or considerable. Character, that has been slowly molded by certain influences, acting for long periods, will not be modified immediately by the withdrawal of those influences. Whatever deterioration occurs, whatever new hardships make the lot of woman more tragic, will only appear after adverse influences have had their full term of operation.

Neither in readjusting the duties toward society of the sexes respectively are men likely to insist that, in taking full political powers, women shall surrender any or all of their present immunities and privileges. The relation of the contracting parties is not one that will make any such rigid and hard bargain possible. But that surrender will inevitably be brought about by the indignant disdain of the women, who will have effected the social revolution, at being the recipients of any privileges which differentiate their situation or hamper them in their complete development. The inevitable ultimate result of subjecting the two human sexes to the same labors, the same employments, the same cares, will be just the same as when domestic animals have been subjected for long periods to the same conditions: sexual differences, physical and mental, will tend to disappear, and the two branches of the race will approximate a common type.

He has inadequately considered the nature of the demands

made by that section of womanhood in insurrection against the present social order, and the implications which lie behind their specific demands, who does not see the radical changes that will come finally as a result of conceding these demands. However disastrously the experiment may issue, the difficulties of either turning back or arresting the movement will be nearly insurmountable.

Certain discontented women say they want the ballot, in order that they may with it open to themselves, on the same terms and for the same compensation, a free career in all the professions and occupations in which men are engaged. They want to place all women in the condition of service and hardship in which the casualties of life and the precarious fortunes of business now place a few women. They wish to make wounds which the present social structure now receives here and there parts of its normal status. For they want to be lawyers and physicians charging the same fees, ministers having the same salaries, artisans and workmen having the same wages as men. The greater competition among the many women as against the few men in the occupations now open to women they propose to counteract by a statutory equalization of wages for the same kind of work.

The great labor crises and the imperiled industrial equilibrium in the whole civilized world being confessedly due to the excessive number of competitors for such paying work as machinery has left to be done, it is proposed to aggravate the situation by turning into the competition the whole mass of able-bodied women, not hitherto generally reckoned among the working class.

In the woman-suffrage movement the "insurgent women" virtually serve notice upon us men, that they do not desire any of our courtesies, which are a badge of their servitude, and that our politeness in giving them the best places in the concert room and the horse-car is superserviceable and compromises their sense of independence. They do not longer care to be petted or exempted from perils and hardships or to be maintained by labor not their own. They only want an equal chance to "*paddle their own canoe*" in quest of their own fortunes.

Whatever the answer to this demand may be, it will not be likely to be this: Very well, please yourselves; rough it with us in the struggle for life, asking no favors if such a contest invites you. Enlist in the military companies and stand the drill, and when the next war comes, go to the front. Join the fire company in your ward, and run with the machine, when the next fire calls you out at midnight. There is a ship in port bound round Cape Horn, on a year's voyage; the owners have had such bad luck with drunken men, that they mean to try a crew of

athletic girls. Go up the Penobscot and live next winter in a camp, and come back next spring balancing yourself with a pick-pole on the floating, slippery logs you have cut. Go down into the mines, and with your pickaxe and shovel dig coal and iron. Offer your services at the going wages to run a locomotive, to blast rocks, or handle dynamite.

Men who are husbands, fathers, and sons will not say this or anything like it. But when the lawyer finds his female competitor by the charms of her beauty and eloquence winning his clients; and the doctor, that the woman physician by her motherly tenderness has seduced his patients; and the minister, that some reverend lady by her superior sanctity has supplanted him in his parish; and all men in all their vocations, high and low, by whose toils they had gained bread for their families, are pressed with the competition of those it had been their chief spur to industry and their pride to maintain without the necessity of repulsive work, will not the feeling become universal that men are released from their obligations of duty and support toward the weaker sex?

The naturalists tell us that the human race acquired its strong parental affections by performing the needed offices of care and help which the prolonged infancy of its young—so much longer than among all lower animals—made necessary. We know that the tenderness, affection, and sympathy which are the essential grace and charm of womanhood, as well as the courage, disinterestedness, and chivalric sentiment which form the nobility of manhood, have sprung from that very relation of strong to weak, protector and protected, which have for ages subsisted among all the civilized races. What guarantee can they give us who are seeking to destroy that relation, or at least the cause and reason of its existence, that those cardinal virtues that adorn and dignify both sexes will not be involved in its destruction? For one, I should not dare to vote to drag woman from the high estate in which man honors himself in being her minister and servant, until at least the intelligent majority of women deliberately express their judgment in favor of a social change so consequential.

Harvard College Observatory has adopted the plan of sending out circulars to the scientific press and other interested parties, to announce discoveries as they are made, and secure earlier publication of them. The first of these circulars announces the discovery by Mrs. Fleming, from examination of the Draper memorial photographs, of a new star, *Nova Carinæ*, which appeared in the constellation Carina in the spring of 1895. A comparison of its spectrum with those of Nova Aurigæ and Nova Normæ shows close resemblance and apparent identity in essential features. Between April 8 and July 1, 1895, the photographic brightness of the star appears to have diminished from the eighth to the eleventh magnitude.

NATURAL SCIENCE IN A LITERARY EDUCATION.

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THE greatest forms of literature hold the mirror up to Nature —that is, to life. Literary conventions, even, go back at some point to real life. Because actual Sicilian shepherds once piped their happy songs where Theocritus heard them, the world has had its long line of pastoral poetry, an intolerable deal of the sack of empty repetition and formalism to one half pennyworth of the bread of reality. In spite of traditions, however, the more important literature of the world has kept in touch with actual life. Of Shakespeare and Chaucer we can confidently say that, though each had a library at home, he found another and a better one upon the street.

Modern science has invaded modern life; its devices meet us at every turn, its great conceptions fill our minds. What shall be the attitude toward science of those students who wish a literary education? Shall they devote themselves entirely to the study of the classic productions in the languages of ancient and modern nations? or shall they take up also those advancing lines of scientific investigation and speculation which are producing new instruments for everyday life and new themes for thought, and which are fashioning anew the very minds and language of men?

The clearness with which Wordsworth foresaw, in 1800, that poetry itself would in the time to come draw its subject-matter more and more from the domain of science, seems truly marvelous. He said in that year, in the preface which he wrote for the second edition of the Lyrical Ballads:

"If the labors of men of science should ever create any material revolution . . . in our condition and in the impressions which we habitually receive, the poet will sleep then no more than at present; he will be ready to follow the steps of the man of science. . . . The remotest discoveries of the chemist, the botanist, or mineralogist will be as proper objects of the poet's art as any upon which it can be employed, if the time should ever come when these things shall be familiar to us, and the relations under which they are contemplated by the followers of these respective sciences shall be manifestly and palpably material to us as enjoying and suffering beings. If the time should ever come when what is now called science, thus familiarized to men, shall be ready to put on, as it were, a form of flesh and blood, the poet will lend his divine spirit to aid the transfiguration, and will welcome the being thus produced as a dear and genuine inmate of the household of man."

The literature of an age takes up into itself the whole mental life of the time. He who would adequately interpret modern literature should know modern life, and in that life science is a marked element. A general knowledge of contemporary science is needed to interpret contemporary literature. Tennyson, for example, constantly refers to the great scientific discoveries and conceptions of his time. How shall a reader ignorant of those conceptions fully appreciate him? Prof. William H. Hudson, in a remarkable article,* speaks of "Tennyson's keen interest in science; his sympathetic hold upon the vast movements in progress around him; his manly attitude toward the changes that life and thought were everywhere undergoing." Even the casual reader of Tennyson must have noted how deep is his interest in scientific study, and how fully the great conceptions of modern science find expression in his poetry. Indeed, there seems to be a prophetic element in this. As Miss Scudder notes in her recent volume,† it is hard to realize in reading some parts of In Memoriam that it was published in 1850, nine years before Darwin's Origin of Species.

Great forms of thought, mighty molds which of necessity give shape to our thinking and then to our very imaginings—these come to us from the study of things, not from the study of language. Literature itself must largely find its raw material, its great metaphors and similes, its vivid pictures and mighty symbols, within the domain of natural science, and this increasingly as the years go by. The chemist's law of definite and multiple proportions; the laws of motion; the phenomena and laws of light, heat, and electricity; the strata, the glaciers, and the processes of earth-sculpture of the geologist; the winds, tides, and ocean currents; the theories of animal evolution; the struggle for existence, the survival of the fittest; the mighty phenomena, the impressive uniformities, the nebular hypothesis of astronomy —these are great forms of thought as well as facts and theories of science. A man who is unacquainted with modern science can not well understand the language of educated men, and he can not interpret sympathetically and adequately the literature of his own day. Were any writer completely ignorant of these facts and conceptions, he would be unable to make use of some of the most powerful symbols that exist for the expression of ideas. Standing in the midst of a mighty speaking universe, he would find himself, in a measure, tongue-tied because deaf.

Prof. Drummond's suggestive book, Natural Law in the Spiritual World, shows what powerful instruments science furnishes

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* Poetry and Science, Popular Science Monthly, October, 1894.

† The Life of the Spirit in the Modern English Poets.

for the exposition and enforcement of thought. The fundamental importance to the speaker and writer of finding effective symbols for his thought is perhaps best illustrated by the parables of Christ; "without a parable spake he not unto them."

The larger facts of modern science constitute an incomparable challenge and stimulus to the imagination. The electric thrill circles the earth ere a swift-footed Achilles could gird up his loins to run. An instructor in rhetoric in the University of Chicago recently stated that the most vivid and imaginative themes which came to him from a certain class were written by some pupils interested in geology upon simple topics connected with the history of the earth. Some of the great writers of coming days are already

> . . . nourishing a youth sublime
> With the fairy tales of science.

The value of scientific study is not to be measured, of course, by the extent to which it ministers to the production and appreciation of good literature. The necessity of some knowledge of science, in order that the educated man may possess his intellectual birthright as a member of his own generation, furnishes a fundamental and unanswerable argument for such study. That ideal of education will never go entirely out of fashion which demands that each student make a brave and earnest attempt, even though it can never be more than partially successful, "to see life steadily, and see it whole." This ideal will always appeal to some minds, and its advocates will judge colleges and universities by their success in furnishing education of this type.

Is there any practical difficulty besides the obvious limitations of time and strength which prevents students of literature from obtaining an outline knowledge of the more important branches of modern science? Unquestionably, the great difficulty is a conviction on the part of these students themselves that scientific study is without value for them. But in some cases this is not the only obstacle. Some of the introductory courses in science in the American institutions of collegiate grade seem to be planned for those who wish to make specialties of the sciences. Brief, synoptic culture courses—such as can be covered, let us say, by means of a daily class exercise for a period of twelve weeks—are accessible in many institutions, and sometimes in all of the major sciences; but in other cases they are disbelieved in and are not offered. In study of this sort, of course, two or three hours of field or laboratory work often take the place of a lecture or recitation. Sometimes the first course in a particular science, while brief enough to come under the description given above, is evidently planned entirely as "first steps," not as a synoptic course that shall by itself minister to a broad culture.

I grant that literary students should study some one fundamental science more fully than I have indicated, as a guard against habits of superficiality; but if they are to make any such acquaintance as it seems to me that they should with the "circle of the sciences," it must be by means of synoptic culture courses, since their literary studies will of necessity claim most of their time.

Some scientists will think my proposal foolish and impracticable. It will seem to them absurd that a man should try to study chemistry, for example, especially on the side of its value for mental culture; that he should be vitally interested in the fundamental facts of metallurgy, in the law of definite and multiple proportions, and the atomic theory, and have only a very languid interest in bad smells and the details of the chemical laboratory. But I know that there are scientists whose standing is unquestioned who believe in the value and practicability of the courses that I am advocating.

Undoubtedly some work in natural science can be satisfactorily accomplished in the schools preparatory to college. The more external study of plants and animals should be made prominent here. Ornithology in particular, now that Mr. Chapman's admirable handbook and helpful works by others have been published, may well furnish delight and refreshment to the youth of the present and coming generations. Who can fail to be interested in birds—in voiced sunshine and winged music—especially when the appeal is re-enforced by such writers as John Burroughs, Olive Thorne Miller, Bradford Torrey, and Frank Bolles?

I can not think, however, that other branches of natural science can be handled in a manner adequate to the needs of a broad education in the secondary schools. A certain preparedness of mind for college courses and a very moderate amount of acquirement seem to be all that can be expected in many departments of science from such preparatory work; but I am not entitled to have a very definite opinion on this point.

If I say a few words in favor of natural science as a mental discipline, I shall take a line of argument that is not now popular. Still, the educational world has its fashions. Our present way of thinking, therefore, may change, at least to some degree; and mental discipline in education, the old idea of to-day, may become one of the new ideas of to-morrow.

Since Harvard University gave to its undergraduates practically complete freedom in the choice of the courses which lead to something that it was nevertheless decided to call the A. B. degree, the principle of election in undergraduate study has had free course and been glorified. Some persons would even claim that the various departments of study are substantially equal and identical in disciplinary power and general educational value.

This proposition I can not accept. Literature, for example, is an indispensable element in an education, but it does not give all kinds of knowledge and mental training. Those students who look upon literature as in itself an education will find—or others will find it out if they do not—that they have accepted it in some measure instead of an education. One can not omit the other great subjects from his training, and then make up for their loss by reading his Browning, his Chaucer, or even his Shakespeare, more often and more strenuously. The mathematics and the more exact physical sciences help, as no other branches of study can, to give to the mind habits of accuracy and a sense of proportion. In a class in literature many questions do not admit of exact answers; the personal element must come in; the answers of the most careful instructor are only an approximation to the truth; the answers of the most superficial scholar will not be entirely wrong. Indeed, since a literary masterpiece makes its appeal primarily to the emotions and the imagination, the whole conception of definite, exact answers to specific questions has but a limited application to the work of the class in literature. In mathematics and the more exact physical sciences each problem is specific, and has one answer that is exactly right; all other possible answers are exactly and entirely wrong. Every man needs the discipline of such study.

Let the man interested in literature study mechanics. When he learns that many forces differing in quantity and direction can all combine in a single resultant motion, he will not be quite so ready in studying literary movements to fix the attention upon one force or circumstance and neglect all the others. Let him study chemistry; let him determine all the elements in a given compound, and how much of each is present; then he will not be quite so apt, when analyzing a piece of literature, to fix the attention upon one quality and ignore everything else.

Even professional literary critics are often decidedly lacking in proportion, poise, and sharpness of outline. Let me illustrate. Mr. Swinburne speaks thus of Collins: "He could put more spirit of color into a single stroke, more breath of music into a single note, than could all the rest of his generation into all the labors of their lives." * The same critic comments as follows upon some of the poems of Keats: "The Ode to a Nightingale, one of the final masterpieces of human work in all time and for all ages, is immediately preceded in all editions now current by some of the most vulgar and fulsome doggerel ever whimpered by a vapid and effeminate rhymester in the sickly stage of whelphood." †

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* Ward's English Poets, iii, p. 282.

† Encyclopædia Britannica, article upon Keats.

I do not care now to object to the qualitative judgments here expressed; but how about the quantity of praise and blame that is bestowed? Is it probable that the writer of these words ever had much thorough training in the mathematics and physical sciences? Indeed, can he ever have studied anything quantitatively?

It is not my main purpose, however, to argue for the disciplinary value of scientific study; its more direct and substantive value for the student of literature is what I have wished especially to set forth. There seem to be two great types of collegiate education, the literary and the scientific. That natural science has an important rôle to play in the ideal literary education I firmly believe; and in support of this position I appeal to the prophecy of Wordsworth, to the poetry of Tennyson, and to the reason of the case.

RECENT WORK ON THE X RAYS.

THE general interest which the so-called Röntgen rays have excited among the unscientific as well as among the specialists seems to justify a more extended treatment than their actual value to humanity, so far as at present known, would warrant. The following extracts are taken from the published statements of some of the more prominent physicists. They are more or less tentative, as all such work at present must necessarily be; but they are of interest, as showing the lines along which experimentation is going on, and they perhaps offer some indication of the probable future of this curious form of energy.

In a paper read before the Paris Academy of Sciences M. Jean Perrin says: "Two hypotheses have been propounded to explain the properties of the cathode rays. Some physicists think with Goldstein, Hertz, and Lenard, that this phenomenon is, like light, due to vibrations of the ether, or even that it is light of short wave length. It is easily understood that such waves may have a rectilinear path, excite phosphorescence, and affect photographic plates. Others think, with Crookes and J. J. Thompson, that these rays are formed by matter which is negatively charged and moving with great velocity, and on this hypothesis their mechanical properties, as well as the manner in which they become curved in a magnetic field, are readily explicable." A series of experiments which the author made, and which are given in Nature for January 30th, lead him to the following conclusions. "These results as a whole do not appear capable of being easily reconciled with the theory which regards the cathode rays as being ultra-violet light. On the other hand, they agree well with the theory which regards

them as a material radiation, and which, as it appears to me, might be thus enunciated. In the neighborhood of the cathode, the electric field is sufficiently intense to break into pieces (into *ions*) certain of the molecules of the residual gas. The negative ions move toward the region where the potential is increasing, acquire a considerable speed, and form the cathode rays; their electric charge, and consequently their mass (at the rate of one valence-gramme for a hundred thousand coulombs), is easily measurable. The positive ions move in the opposite direction; they form a diffused brush, sensitive to the magnet, and not a radiation in the correct sense of the word."

Nikola Tesla, in a recent Electrical Review, describes the following experiment, which seems to support the view that these rays are material radiations: When an exhausted bulb is attached to the terminal of a disruptive coil, small streamers are observed which often break through the side of the bulb, producing a fine hole. "Now, the extraordinary thing is that, in spite of the connection to the outer atmosphere, the air can not rush into the bulb as long as the hole is very small. The glass at the place where the rupture is may grow very hot—to such a degree as to soften; but it will not collapse, but rather *bulge out*, showing that a pressure from the inside greater than that of the atmosphere exists. On frequent occasions the hole becomes so large as to be perfectly distinguishable to the eye. As the matter is expelled from the bulb the rarefaction increases and the streamer becomes less and less intense, whereupon the glass closes again, hermetically sealing the opening." He reports producing strong pictures at a distance of forty feet by the use of a bulb with a single terminal, which permits the use of practically any desired potential.

An account of some important experiments by L. Benoist and D. Hurmuzeson appears in the *Comptes Rendus*. They caused the rays of a Crookes tube, incited by a powerful coil, to act upon the gold leaves of a Hurmuzeson electroscope at the distance of about twenty centimetres from the tube, and alternately charged with positive and negative electricity. The insulation obtained by a disk of dielectrine which closes the tube admits of the perfect preservation of its charge for several months. The X rays immediately and completely discharge the electroscope, more rapidly if the charge is negative than if it is positive. "We have thus," they say, "a new way of investigation applicable to the study of these rays, and enabling us to gain important information as to their real nature. The plate to be studied being put in its place, the electroscope charged to about a divergence of forty degrees, the keeping tube replaced, and the Crookes tube set in activity, we have observed:

"1. Black paper (sixteen leaves interposed). The collapse of the gold leaves is immediate and complete in a few seconds; they do not rise again. 2. Plate of brass (two tenths of a millimetre in thickness). No change in the divergence of the gold leaves. 3. Plate of aluminum (one tenth of a millimetre). Immediate fall, complete in a few seconds; same result with plates of aluminum up to one millimetre, and even upward, and the Crookes tube being removed to the distance of thirty centimetres. The substances easily traversed are silver in beaten leaves, leaves of paper steeped in metallic solutions, vulcanized fiber, gelatin, celluloid, ebonite, etc. The substances not traversed, at least in the thicknesses employed, are brass, zinc, glass, and unglazed porcelain (three millimetres). Similar results have since been announced from several other investigators."

A paper by G. Jaumann, under the title of Longitudinal Light, is described in Nature: "It is based upon the law of electric discharge enunciated by Jaumann in 1888, according to which electric rays impinging at right angles upon a cathode surface favor the dissipation of the charge upon it. Hence, the writer argues, light vibrations must have a component in the direction of propagation; they must, in fact, contain longitudinal as well as transverse waves. It then becomes a question of how Maxwell's electro-magnetic equations, which do not admit of any but purely transverse vibrations, can be made to agree with these conclusions. Jaumann gives a simple answer. Let it be admitted that the specific induction capacity of a medium and its magnetic permeability are affected by the oscillations themselves. These 'constants' will then be variable, and when introduced as such into the equations longitudinal vibrations are at once seen to be possible. Each pencil of light will then be vibrating transversely along its center line, and toward the outer edge the vibrations will become more and more longitudinal. The author claims that this theory affords a natural and simple explanation of a large number of discharge phenomena."

Prof. Oliver Lodge, of University College, Liverpool, is reported as having said that he felt inclined to adopt the view that the new rays were longitudinal waves in the ether; and that if this were so the discovery would open up a department of physics as large as light, sound, or electricity. Later, in a letter to Nature, discussing the theory of the anodal origin of the X rays, he says: "The term 'anode rays' for the rays discovered with so much *éclat* by Prof. Röntgen, whether they be the same as those previously discovered by Dr. Lenard or not, is suggested by the remarks of Mr. A. W. Porter at a recent meeting of the Royal Society. They certainly do not start from the cathode, but from some opposed surface—a surface which may be an actual anode,

and which always has some anodic properties. From each point of such a surface rays start in all directions; this is proved by the shadows they cast of slits, holes, and wires."

Prof. S. P. Thompson takes exception to the term anodic, as applied to the X rays. He says: "Is it quite correct, as Prof. Lodge puts it, to call the X rays anodic, because they start from a point opposite the cathode? It may be true that a surface upon which the cathodic discharges are being directed acquires thereby some properties common to the anode, but it is not an actual anode; . . . hence I submit that *anti-cathodic* would be a more correct term to use in describing them."

Prof. A. W. Porter, of University College, London, in a letter to Nature, says: "In your last issue, in the account of the work in the *Comptes Rendus*, you state that M. de Heen 'proves conclusively that the X rays proceed from the anode and not the cathode.' May I point out that I have proved that this is undoubtedly true for the bulb I have been using *throughout* my experiments on the X radiation? The bulb is one in which the negative electrode is concave, and the negative stream is thereby focused to a point on the anode, which is a platinic disk placed near the center of the bulb. By measuring the positions of different parts of a radiograph of a series of concentric zones of tin foil placed in a measured position, I have shown that the actinic rays diverge from the anode disk."

It was announced from Rome that Prof. Salvioni, of Perugia, had discovered a means by which these radiations could be made to so far assist the eye as to enable it to see through all objects which the rays could penetrate, so that the contents of a closed space were revealed.

From Prof. Salvioni's description of the apparatus, which follows, it will be seen that he has made no new discovery, and that it is quite incorrect to say that the observer actually sees the objects. He simply sees the shadows on the phosphorescent screen. The fluorescent light affects the retina like ordinary light, and is quite distinct from the X rays. What is really seen is a shadow picture of the object.

The apparatus is very simple, and is thus described by Prof. Salvioni: "This cryptoscope consists of a small cardboard tube about eight centimetres high. One end is closed by a sheet of black paper, on which is spread a layer of fish glue and calcium sulphide; this substance I have found to be very phosphorescent under the action of Röntgen rays. Within the cardboard tube, at the other end, at which the eye is placed, is fixed a lens, giving a clear image of the phosphorescent paper. On looking through this cryptoscope one can see, even in a light room, the shape and position of metallic bodies inclosed in boxes of cardboard, wood,

aluminum, and within the flesh." These experiments have since been repeated by many other investigators with perfect success; the observer in one case examining the bones of his own hand.

Gustave le Bon, in the *Revue Scientifique,* in summing up the results of his experiments on the X rays, says: "These experiments, which have been varied in all ways, are fundamental. They show us that the degree of thickness of the opaque plates is absolutely without importance in the passage of the '*lumière noire.*' They also indicate that the '*lumière noire*' is propagated under other laws than those which govern ordinary light. . . . This light can be transformed into radiations which propagate themselves as electric currents. They are not, however, electric radiations, because they produce effects which ordinary electric currents will not produce. We find ourselves, then, in the presence of a form of energy which is not light, as it only has part of light's properties and does not obey the laws of the propagation of light, and which is not electricity, since electricity in all known forms does not produce the same effects. The '*lumière noire*' must be considered as a new force added to the few of these which we already know."

In a letter to Nature, Lord Blytheswood describes the following experiment with a Wimshurst electrical machine of one hundred and twenty-eight three-foot plates, the machine being driven by a motor of about one horse power and a half. "A thick sheet of lead was placed upright between the poles of the electric machine, as a screen, and was connected to the ground, the two poles being insulated. A sensitive dry plate was put into the camera dark slide, with a metallic object to be photographed (a steel washer with holes in it), and this was connected by a wire which passed out of the dark slide to the ground. The whole was wrapped up in four folds of a black velvet focusing cloth, and was put in some cases between the negative pole and the lead screen, and in other cases between the positive pole and the lead screen, the plane of the slide being perpendicular to the line of discharge. In all cases good strong negatives were obtained with exposures of about twenty minutes. The machine was arranged to give a silent brush discharge during the experiments." Several other physicists have reported obtaining shadow pictures without the aid of a Crookes tube, by using an electric current or simple sunlight, and a fluorescent screen, after very long exposures. Henri Becquerel recounts the following interesting experiment: "I inclose a photographic plate in two folds of very thick paper, so that the plate does not become shaded on exposure to the sun for a day. On the outside of this paper a plate of phosphorescent material is placed, and the whole is exposed to the direct rays of the sun for several hours. When the plate is developed we find

that the silhouette of the phosphorescent substance appears in black on the proof. If a coin is interposed between the phosphorescent substance and the paper, its image appears on the proof. A thin sheet of glass may be interposed to preclude the possibility of chemical action."

It is announced by Mr. Edison that calcium tungstate (properly crystallized) gives a splendid fluorescence with the Röntgen rays, far exceeding that of platino-cyanide.

A rather ingenious explanation of the X rays is offered by Mr. J. W. Gifford. He likens the Crookes tube to a vibrating tuning fork, which, if sounding simple A, would set an A violin string vibrating not only A but its octave and the fifth to its octave, and quite a host of other overtones or harmonics of rapidly decreasing wave length which would seem to have no theoretical limit. The waves of long period from a Crookes tube would pass through wood, paper, or the human body, without much resistance, but would be absorbed or reflected by the denser metals. But if objects capable of taking up their vibrations lay in the path of these long rays they would set them vibrating like the violin string, and might in the same way produce overtones which did not before exist. These overtones may include waves of such short lengths as to cause the objects themselves to become luminous. If so, the light waves in question, although they are distinctly instrumental in darkening a photographic plate exposed to them, have nevertheless not passed through, and could never pass through the obstacles easily traversed by the electric waves which gave them origin.

Prof. Ogden N. Rood, of Columbia College, has quite recently published in Science an account of some important work on the reflection of these "rays." The mirror used was a new sheet of ordinary platinum foil. Great care was taken to prevent any rectilinear emanations from the discharge tube reaching the sensitive plate, which was contained in an ordinary plate holder, being covered with two sheets of aluminum, each 0·17 millimetre in thickness, and the draw slide, and over the whole was fastened a netting of iron wire. "After an exposure of ten hours it was found that a good image of the netting had been produced on the vertical strip of the plate exposed to the reflected rays. This image had various deformations, the vertical lines representing the netting being, as a general thing, most distinct; in some places, however, the horizontal lines had the upper hand, and there were a few spots where both were equally distinct. These facts and the character of the deformations point very strongly to the conclusion that in the act of reflection from a metallic surface the Röntgen rays behave like ordinary light." Further experiments were made to ascertain the percentage of the rays

reflected. The result arrived at, which Prof. Rood says is only to be regarded as a first approximation, was that platinum foil reflects the one two-hundred-and-sixtieth part of the X rays incident on it at an angle of forty-five degrees. Prof. G. Vicentini and Dr. G. Pacher, in a paper read before the Reale Istituto Veneto di Scienze, report having found distinct evidence of an irregular refraction from a parabolic brass mirror.

Regarding the value of these rays in surgery there are at present hardly sufficient data to warrant a positive conclusion. However, a most thorough and profusely illustrated article appeared in the American Journal of the Medical Sciences for March, 1896, entitled The Clinical Application of the Röntgen Rays. It is much the best exposition which this branch of the subject has yet received, and if one can depend on the pictures, the new agent promises to be, if nothing more, at least a great aid to diagnosis.

An interesting commercial application of the rays is announced by Bugnet and Goscard in the *Comptes Rendus.* "The proofs which we have the honor to submit to the Academy show in juxtaposition silhouettes of genuine diamonds and of imitations, both loose and set. Prolonged exposure soon succeeds in causing the silhouettes of genuine diamonds to disappear, while false diamonds continue to behave like opaque substances. The same procedure has also enabled us to distinguish natural jet from its mineral imitation."

At a meeting of the Royal Society, on February 13th papers on the Röntgen rays were read by Lord Kelvin and Prof. J. J. Thompson. A discussion followed, the general tone of which showed that, although many interesting points have been cleared up, there is still considerable difference of opinion among the authorities regarding fundamentals, and, while extremely valuable experimental work has been done, we are yet far from a final explanation of the origin and properties of this new (?) form of energy.

The following, from an unbeliever, may perhaps be of interest: Ch. V. Zenger says, in speaking of some pictures obtained by Domalip, Professor of Electrotechnics at the Polytechnicum of Prague: "The interesting point is that Domalip has obtained electric images on a plate by means of plates of copper, brass, zinc, lead, and steel. This is, in my opinion, the proof that there is here merely a phenomenon of electric induction producing phosphorescence of the gelatin, and at the same time an electric discharge in the gelatin, and, lastly, the fluorescence of the ambient air, and as in case of the dark discharge of electricity. In my opinion, these are the three agents which determine the decomposition of the silver salts in the sensitive layer. There are no special radiations, no X rays, and no dark light."

SKETCH OF HENRY AUGUSTUS ROWLAND.

By CHARLES EDWARD LLOYD.

AMONG the distinguished physicists America has produced Prof. HENRY AUGUSTUS ROWLAND, of Johns Hopkins University is unanimously accorded a leading place. He was born at Honesdale, Pa., November 27, 1848. His forefathers were among the earliest settlers of Fairfield, Conn. Three generations of clergymen of well-known prominence in the Congregationalist Church of Windsor, Conn., are his immediate paternal ancestors. His father, the Rev. Henry Augustus Rowland, had a great love for all scientific pursuits, and only gave them up for what he considered a higher calling. Prof. Rowland's mother is descended from representatives of several Knickerbocker families of Manhattan Island. She was Harriette Heyer, the daughter of a wealthy merchant of New York. Her mother was Miss Suydam.

In 1855 Prof. Rowland's father removed to Newark, N. J. He died there in 1859. Prior to his death, however, he had discovered the scientific bent of his young son, and heartily sympathized with and encouraged it. During the residence of his family in Newark the boy spent most of his time making chemical experiments. He used a book on chemistry belonging to an older sister, and worked in a crude laboratory he made for himself in the cellar of his father's house. Between the ages of eleven and fifteen he also commenced experiments in electricity and magnetism, making many small electric motors, electric machines, and repeating all the experiments he could find mentioned in the few scientific books to which he had access.

When he was about sixteen years old his mother sent him to Andover, Mass., to prepare for college. While here he was so engrossed in his electrical and magnetic experiments that his Greek and Latin studies were neglected. He was severely reprimanded by Mr. Taylor, the head of the school. This lecture, delivered to him in an arbitrary manner, without any inquiry as to the cause and with no word of kindness or sympathy, made a profound impression on the boy and increased, if possible, his dislike for the stones of the Latin and Greek languages which were forced upon him when he was starving for the bread of scientific knowledge. On returning home from Andover he expressed his dislike for this course of study so strongly to his mother that she determined to send him to the Rensselaer Polytechnic Institute at Troy, N. Y., at that time the leading engineering school in the country. Here the young man maintained a good position in his classes, although much of his time was spent in his own experi-

ments and studies. The subjects taught, however, were so congenial to him that one reading of the lessons assigned him was sufficient to insure a creditable recitation.

Owing to an injury to his knee during a snowball fight, he gave up his classes in Troy and studied chemistry for half a year at the Sheffield Scientific School. Here he invented and made the first continuous current dynamo ever constructed, which has since been exhibited at the World's Fair at Chicago. Young as he was, he was busily engaged in researches and experiments on magnetism. He was an earnest student of Faraday's Researches, Tyndall's Heat, Youmans's Conservation of Energy, and books of similar nature, although he had never studied the subject of physics under a competent teacher.

He returned to Troy and was graduated in 1870 with the degree of C. E. On his return home he continued to work on his favorite subjects of electricity and magnetism. About this time he published his first paper, a letter to the Scientific American describing a visit to an inventor, who professed to obtain great power from a single cell of a battery. Mr. Rowland, being familiar with the laws of the conservation of energy, knew there must be some swindling device somewhere, and finally exposed it, although a number of capitalists had already been defrauded of large sums of money by this man's claims. For part of a year Mr. Rowland was connected with a railroad in western New York as civil engineer, but routine work of this nature was so distasteful to him that he accepted the place of Instructor in Natural Science in Wooster University in Ohio. After a few months' experience here, he went to Troy, N. Y., to teach physics. During this period he had been engaged in researches on magnetic distribution, and what is now called magnetic permeability, using a system of absolute magnetic units of his own invention and calculating many cases of magnetic distribution by the method of the magnetic circuit, now always used for the calculation of dynamos and motors, and often ascribed to Hopkinson, but really due to Rowland. These researches he rewrote three separate times, and sent for three consecutive years to the leading scientific journal of America. Each time the editor, who was not a physicist, said that he had consulted the most eminent physicists of the country, and their advice to Mr. Rowland was that he had better study the subject before attempting to write any more papers. This criticism naturally discouraged and depressed the ambitious and studious man. Since his earliest youth he had studied electricity and magnetism in spite of all opposition, traveling from place to place with his trunks full of galvanic batteries and electrical material, never receiving one word of encouragement, but always looked at askance as one no better than he

ought to be, or reprimanded by ignorant pedagogues for not studying languages, dead in every sense to one who could judge of the relative value of things. This repeated rejection of his manuscript by the leading American journal was the most depressing factor in his life.

About this time, Maxwell's great work on Electricity and Magnetism appeared, and Mr. Rowland recognized there the system of units which he had himself invented, as well as many other of his ideas. He also recognized in the author a master mind of the very highest order. He compared this work with his rejected manuscript and said to himself: "This is the judge I want; I am either a fool, suitable for an asylum only, or my work is good. I shall send my papers to this great man and find out." The paper went, and the kindest of letters from the great Maxwell came back, saying that the *paper was of the highest value, and had been sent to the Philosophical Magazine of London!* This verdict naturally eliminated the "depressing factor" above referred to.

This "paper" appeared promptly and established Mr. Rowland's reputation. It is considered to-day the beginning of the modern exact study of magnetism. It was, perhaps, the main cause of his selection for the chair of Physics in the Johns Hopkins University.

While teaching at Troy, he visited his uncle, who was chaplain at West Point. Here he first met Prof. Gilman, who had just been elected President of the projected Johns Hopkins University. Prof. Rowland had been cordially introduced to Prof. Gilman by Prof. Michie. President Gilman was anxious to secure the best man in both hemispheres for the chair of Physics in the new university, over which he was to preside, and at his suggestion the Board of Trustees of Johns Hopkins University wrote to Clerk Maxwell, Lord Rayleigh, Lord Kelvin (then Sir William Thompson), Baron von Helmholtz, and other European scientists for the name of the ablest physicist known to them. With singular unanimity these foreign specialists replied that the most original thinker in the domain of physics was, in their opinion, an American named Rowland, of the Rensselaer Polytechnic Institute, of Troy, N. Y.! Thus indorsed by Europe and America, the position was offered to Prof. Rowland and accepted. He still holds it.

When this flattering offer was accepted, Johns Hopkins University was not prepared to open its doors to students, and President Gilman suggested that Prof. Rowland should take a year's leave of absence. This suggestion coincided perfectly with Prof. Rowland's plans. He went abroad, and was for a while the guest of the great Maxwell. Now, for the first time, he

was able to converse with one who knew more about his favorite subjects than he did. The wonderful and profound knowledge of Clerk Maxwell, combined with a childish simplicity and the kindliest of natures, made a great impression on Prof. Rowland. He looks back to this visit as one of the most notable events of his life. From England he went to France, thence to Germany, where he entered the laboratory of Baron von Helmholtz. It was here he carried out his research on the magnetic action of electric convection—an idea he had conceived in 1868 while reading Faraday's Researches. He returned to America in 1876, and assumed his duties as Professor of Physics in the Johns Hopkins University.

Prof. Rowland was at this time only twenty-seven years of age, a period at which many of his graduate students now begin the study of physics under his able tutelage. His students are sincerely attached to him, and have so profound a respect for his knowledge and ability that many of them emulate his example and gladly spend hours of extra time in testing interesting experiments suggested by his lectures.

First Continuous-Current Armature, made by Prof. Rowland in 1869.

During the early years of Prof. Rowland's life in Baltimore he made a new determination of the mechanical equivalent of heat, in which he introduced exact thermometry for the first time. He made a considerable correction in Joule's value. He also discovered that water had a minimum value of its specific heat, a fact unnoticed before. Soon after he made a determination of the unit of electrical resistance, the ohm, which demonstrated the error of the British Association Committee. This experiment he repeated with a Government appropriation as a member of the International Congress for fixing this standard. When this congress met at Paris, in 1884, Prof. Rowland protested against the value there adopted, as it did not agree with his experiment. At the Congress of Electricians, held at the Centennial Exposition at Chicago, in 1893, the International Chamber of Delegates, of which Prof. Rowland was president,

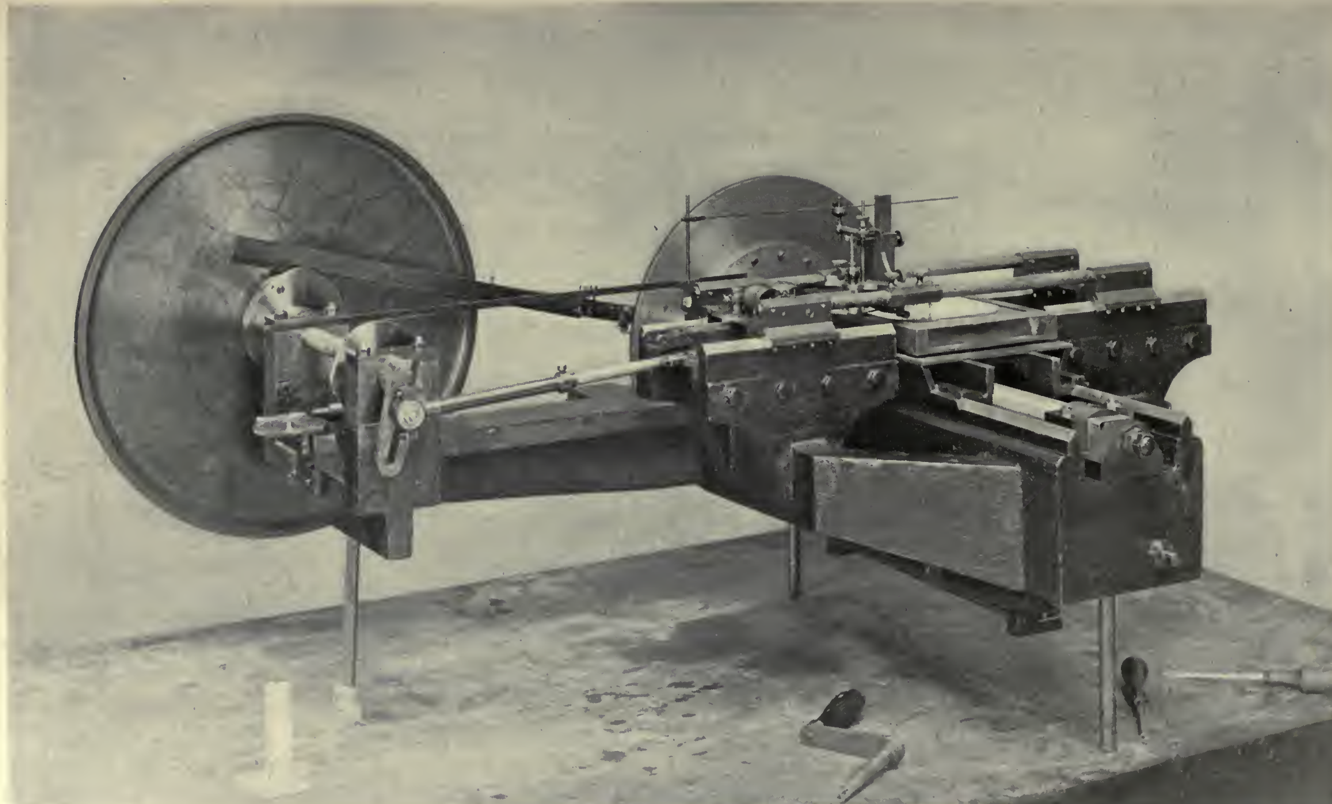
decided unanimously to adopt the value advocated in 1884, and this is now the standard of the civilized world, a triumph of which Prof. Rowland is very proud.

Prof. Rowland's work in physics not only includes that published under his own name, but his influence is felt in the theses of his students who aspire to the degree of Doctor of Philosophy. One of the most notable of these was written by S. H. Hall, and describes a new phenomenon now known as the "Hall effect." The experiment leading to this discovery was described by Prof. Rowland in his lectures, and Mr. Hall was encouraged by his teacher to carry it out to a successful termination. The influence of Prof. Rowland's students in the recent revival of interest in physics, including electricity and magnetism, has been considerable, and the highest position in practical electricity available to an American is held by Dr. Louis Duncan, President of the Society of Electrical Engineers, who is associated with Prof. Rowland and is one of his students.

Prof. Rowland has, with rare exceptions, devoted his time to pure research, and has never endeavored to accumulate a fortune. If he had patented his dynamo, which was finished ten years before Edison applied for a patent, his bank account would be large enough to enable him to perfect any idea he might conceive. Of late years Prof. Rowland has devoted himself principally to the improvement of the apparatus for use in spectrum analysis. He has made three dividing engines for ruling the gratings used, each better than the one before it, and each producing gratings better than those of Mr. Rutherford, hitherto admitted to have been the best. At the present time, all the work of the world in spectroscopy requiring high dispersion is made with "Rowland's gratings."

Prof. Rowland has also invented the concave grating which can be used without lenses, and with which photographic work is best done. These results have been achieved principally by Prof. Rowland's skill as a mechanical designer, and his dividing engines have been constructed not only after his own design, but by processes invented by him and carried out under his own eye. So far nobody has been able even to copy the machines, although the processes have been freely described in his article Screw in the Encyclopædia Britannica.

"Rowland's grating" is made by ruling parallel lines on a concave plate of what is known as speculum metal. This metal is an alloy of two parts copper and one part tin. The parallel grooves are made with a delicately adjusted diamond point. The machine on which the grating was made was manufactured after eighteen months' hard work by Theodore C. Schneider, the machinist at the university (a pupil of George M. Phelps, of Brooklyn), from the



Dividing Engine for Ruling Gratings (the Second constructed).
The legs are slender and put in loosely in order to prevent the tremors of the earth reaching the working parts.

designs of and by processes invented by Prof. Rowland, who was constantly at hand to direct every movement. This machine is in a dark vault under the laboratory. When a "grating" is being made, it runs night and day. The vault is locked, and no one is allowed to enter it, for the machine is so sensitive that the temperature of a human body would disarrange it. When a new diamond point is being tested, as is now the case, Prof. Rowland will permit a few people to visit it. Sir William Thomson, the Earl of Rosse, Lord Rayleigh, Prof. Ball, Astronomer Royal of Ireland, the late Prof. Helmholtz, of Berlin, Prof. Mascart, of Paris, and Prof. Lemström, of Sweden, are among those to whom this courtesy has been extended. The motive power of the machine is a hydraulic engine. The water is kept at a constant height in a tank near the roof, to insure unvarying speed. It is driven by a belt attached to a solid brass driving wheel on the machine. A crank is turned by the same on the other end of the shaft. This crank moves the carriage that conveys the diamond point back and forth over the surface of the "grating" or plate. This carriage rests on two steel ways, which are flat on top and slanting slightly outward, so that there are three points on one way or rail on which the carriage rests. These "ways" are ground so as to make them as nearly accurate as possible. But they can not be made perfect, for Mr. Rowland tested them with a microscope and found that they were "out"—that is, not exactly perfect—by one fifty-thousandth of an inch. He did not attempt to improve them.

One of the most difficult problems that Prof. Rowland and Mr. Schneider have to solve is to find a diamond point that is exactly right. Some are too blunt, some have one defect, some another, and it generally takes from two to eight months to find an available diamond.

As the diamond carriage moves exactly in the same line backward and forward every time, the metal plate or grating beneath must move slightly when the diamond makes a stroke. These tiny grooves must be exactly the same distance apart, and as there must be from ten thousand to forty-eight thousand parallel grooves or lines made within the space of one inch, it is readily seen that the lateral movement of the metal plate is very small. At every stroke of the diamond, the carriage carrying the plate is moved by means of a steel screw. It is the only absolutely exact screw ever made. The "ways" mentioned above, when tested by the microscope, are one fifty thousandth part of an inch "out" of the exact, but the strongest microscope can find no flaw in the exactness of the screw. In order to manufacture this screw, it was necessary to make it under water, which was kept at a certain temperature. If it had been made in the air, or the tempera-

ture of the water changed, the slight expansion caused by the friction would have made the threads vary slightly. This would have caused the carriage that runs on it to vary slightly, and consequently the spaces between the grooves on the "grating" would vary, and render it useless for scientific purposes. The screw is turned by a solid steel wheel with seven hundred and fifty teeth on the ring, which is moved the space of one tooth at a time by an ingenious contrivance attached to the driving shaft. The screw having twenty threads, the carriage is moved one fifteen-thousandth part of an inch each time, thus making that many grooves to the inch on the metal "grating." The number of grooves may be regulated. "Gratings" have been made with forty-eight thousand grooves to the inch. By the strongest microscope made, the human eye could not see the lines if there were more than a hundred and twenty-five thousand to the inch. Prof. Rowland says he gets the best results from "gratings" with fifteen thousand grooves to the inch. The machine now in use at Johns Hopkins University is the third of the kind made. The first was completed years ago, and is still in use in the vault. The European, and especially the German universities, have tried repeatedly to make a machine of the kind, but have never succeeded. Hence all their best universities get the "gratings" for their spectroscopes from the machine at the Hopkins.

When a "grating" is completed, it is taken out, tested, packed in a handsome hardwood case, and sent to Mr. Brashear in Allegheny, Pa. This gentleman attends to the sale of the valuable "gratings," which cost from twenty to three hundred dollars. The proceeds are divided between Mr. Brashear and the university.

When these tiny grooves, cut with a diamond point on the polished metal plate, are completed and are perfect, the grating breaks up a ray of light into its various colors as a prism does. Some of the gratings produce "ghosts," and are then considered imperfect. Prof. Rowland deals with these "ghosts" of the spectrum in a recent article in the Astro-Physical Journal, of Chicago. He says: "A periodic displacement of one millionth of an inch in a grating will produce visible ghosts which are seen in the second spectrum and are troublesome in the third. With very bright spectra these might even be seen in the first spectrum. An over-exposed photographic plate would readily bring them out."

With the concave grating Prof. Rowland has made an immense photographic map of the solar spectrum, and has determined a system of standard wave lengths which is now universally adopted. He is now having measured the wave length of every line of the solar spectrum and is determining the elements to which they all belong. This is a work of years, as is also the

measurement of the wave lengths of the spectrum lines of all the elements.

These measurements are carried on mostly by assistants, and are paid for by appropriations made from the Rumford fund, the Bruce fund, or the Bache fund. But, at times, money for this work is very scarce. Nothing can come from Johns Hopkins University, as it has lost so much of its endowment that its work is greatly hampered. Thus, Prof. Rowland, in the prime of his life, and at the age of greatest mental activity, finds himself compelled to relinquish carrying out many of his best ideas. He has determined, if possible, to remedy the defect himself. Whether he will be able to do so remains to be seen, but he has never failed to accomplish his purposes, and those who know him best have found that discouragements only spur him to greater effort.

In this connection, however, he remembers one of the most disagreeable incidents of his life. Recently he worked six months for the Cataract Construction Company, of New York, in developing the plans for the transmission of the power of Niagara, in which he overthrew the plans of their engineers and substituted rational ones. He consulted two friends as to the bill he should render for his services. He accepted their advice, as they were admitted to be the most competent judges in such matters. The company sent him a check for one third of the amount, accompanied by an insulting letter! Although abhorring petty disputes about money, his sense of justice was so shocked at this treatment that he immediately brought suit against them, rejecting all offers of compromise. In spite of the fact that the company was backed by half the money power of New York and its best lawyer, a jury of twelve intelligent and impartial gentlemen unanimously pronounced his bill correct and just.

During the course of Prof. Rowland's life he has received many honors, mostly from abroad, where he is probably best known and most thoroughly appreciated. In 1881 he became a chevalier of the Legion of Honor of Paris, and in 1896, at the centennial of the Institute of France, of which he is a corresponding member, he was nominated officer of the Legion of Honor. At the exposition at Paris, in 1890, his gratings and map of the spectrum received a grand prize and gold medal. About 1881 he received the grand prize of the Venice Academy of Sciences for an essay on the Mechanical Equivalent of Heat. In 1884 Prof. Rowland received the Rumford medal from the American Academy of Sciences in Boston for his researches in light and heat. In 1890 the Draper medal was awarded him for his researches in spectroscopy.

He is an associate fellow of the American Academy of Sciences of Boston, and member of the National Academy of Sci-

ences, Washington; honorary member of the Royal Society, of London; one of the twelve honorary members of the London Physical Society; one of the ten honorary members of the Paris Physical Society; honorary member of the Royal Society of Göttingen; of the Accademia dei Lincei, Rome; Academy of Sciences, Catania, Sicily; of the Manchester Literary and Scientific Society; of the Cambridge (England) Philosophical Society; of the Swedish Academy of Sciences, Stockholm, of the Italian Society of Spectroscopists, etc. He is corresponding member of the British Association, of the Institute of France, etc.

In 1883 he presided over the Section of Physics of the American Association for the Advancement of Science at Minneapolis, before which body he delivered an address, A Plea for Pure Science, which was published and read with great interest throughout the world.

He was foremost among the members of the Electrical Congress at Chicago, and was President of the International Chamber of Delegates for the establishment of electrical units. The students of the University of Chicago, who occupied front seats in the Academy of Fine Arts when this body of learned men was called to order, regarded Henry Augustus Rowland as second only to his great teacher, the late Baron von Helmholtz. It is possible that those who were privileged to be present on that occasion will never again see, on a single platform, so many men of international reputations.

In 1880 the Johns Hopkins University conferred on him the degree of Doctor of Philosophy. In 1895 Yale University conferred on him the degree of LL. D.

In 1890 Prof. Rowland was married to Miss Henrietta Harrison, of Baltimore, who is thoroughly interested in his work, and is in perfect sympathy with him. They have two bright and interesting children. His oldest, a little daughter, Harriette, named for his mother, is four years old. His son, Henry Augustus Rowland, though only three years of age, already bids fair to follow in the footsteps of his distinguished father. The lad is very fond of visiting the physical laboratory, and will for a long time watch with silent and absorbed interest the movements of the intricate machinery, which is kept constantly going under the supervision of Mr. Schneider.

Prof. Rowland is a tall, strongly built man, and can frequently be seen at one of the windows in the basement of the physical laboratory of Johns Hopkins University industriously working and deeply absorbed in making investigations and experiments which the vast majority of his fellow-citizens would not comprehend. Every one who approaches him is at once impressed by his genuineness. His favorite exercise is horseback riding. Dur-

ing the winter he rides every day many miles in the country around Baltimore, and sits his horse like a Centaur. He especially enjoys a fox-hunt of the old-fashioned sort, for which Maryland has been famous for a century, the first requisite of which is such perfect horsemanship that seven-rail fences and deep ditches are not considered obstacles to the chase. A "paper chase" he would probably regard with as much contempt as he does the pamphlets in his "crank library," a collection of so-called scientific papers written by people who know nothing of science. He intends to deliver a lecture soon on the contents of this "crank library."

His vacation is usually spent in his native New England. He cruises along the coast in a small yacht of his own design, in whose seagoing capacity he has great confidence. It is said by some of his students, who assume to know more of nautical science than of physics, that this yacht does not "ride the waves" properly, and that some day they expect to hear that their teacher has been drowned in a rough sea off the Atlantic coast. These critics are not aware of the fact that during his boyhood a part of Prof. Rowland's vacations were spent in New York city, and that his favorite pastime was rowing or sailing his own boat in New York harbor. A glance at the shipping in that port, with steamships and sailing vessels coming from and going to all parts of the world, with ferryboats constantly passing from pier to pier, and the shrill whistle of the omnipresent tugboat constantly rising above the roar of commerce, ought to convince the most skeptical that even as a boy he was a seaman who knew his business.

This sketch of Prof. Rowland's life should be read with pride and interest by every one of his fellow-citizens. It should encourage every ambitious and gifted American youth to persevere in an effort to overcome obstacles which prejudice and ignorance often interpose to obstruct the career of those who are born with mental powers too great to be trammeled by ancient traditions or to be made pliant to an uncongenial routine.

THE thumb is regarded by Mr. B. Whitehead as one of the most important factors of civilization. Without it, or with only a rudimentary and imperfect thumb such as the monkeys have, men could never have made or used arms of offense or defense, and would never have been able to exercise a number of industrial arts by means of which they have improved the conditions of their existence. No monkey can throw a harpoon or draw an arrow with any precision, turn a spindle or twist a cord. This importance of the thumb has been observed by primitive peoples. Sir John Lubbock mentions savages in Australia and Africa who are accustomed to cut off the thumbs of dead enemies to disable them from making reprisals upon them.

Correspondence.

PROFESSOR OSTWALD ON THE MECHANICAL THEORY.

Editor Popular Science Monthly:

SIR: In the last number of your valuable publication appeared an address by Prof. W. Ostwald, of Leipsic, on The Failure of Scientific Materialism, the reading of which suggested the following considerations:

Leaving aside the intrinsic value of his statements, I wish to call attention to the sensational manner in which they are announced, and to the implied claims on them as original thoughts, or, indeed, as the author himself says, as indisputable, though startling, scientific *discoveries*. He tells us that the atomo-mechanical theory, which he styles "scientific materialism," has proved an absolute failure; that he proposes to deal it its death-blow, and lay the foundations of a new and truly scientific doctrine—the "energistic theory"; that, whatever effects his discovery may have on the ethical and religious systems of the world, he is under moral obligation to make known what he has found in Nature: that he is like a sailor who, having discerned "breakers ahead," must warn his fellows of the impending danger; that he has "a duty to discharge," and "should consider it wrong if he failed to speak of what he has seen." Further on he says that, although he is not exactly the discoverer of the new truth "which the departing century can offer the dawning one," he is the first one to see that "we have been in possession of the truth for half a century without knowing it."

Without intending any disrespect to Prof. Ostwald, I must say that the body of his article greatly disappoints the expectations naturally aroused by this solemn preface. While we prepare to see it demonstrated that Newton's law of gravitation is a metaphysical superstition; that the human species is doomed to disappear within the next generation, or some other wonderful and awful novelty, we find nothing but very common theories and hypotheses, which, however important and interesting in themselves, are topics with which we have been acquainted for a long time. His main contention is, that we do not know of matter apart from its "properties"; that these properties are nothing but manifestations of energy; and that, therefore, energy is the only reality of which we can speak with certainty, the belief in a "substratum" or "bearer" of this energy not being warranted by observation or experiment. But whatever the validity of these propositions may be, they are certainly as old as Aristotle, have been repeated by Boscovich, Faraday, and others, and adopted as an ultimate truth, as the fundamental principle of all science and philosophy, by Mr. Herbert Spencer; while among metaphysicians it has been a common doctrine that energy, or *resistance*, is the final criterion of reality. (See J. B. Stallo, Concepts and Theories of Modern Physics, second edition, chap. x; Spencer's First Principles, secs. 63, 68, 71, 73, 74, etc.; Mansel's Metaphysics, third edition, pp. 346–348, 328, 329.) And if, pushing these speculations to their logical consequences, we say that nothing is known to us except as a mental impression, or that, in ultimate analysis, the only reality, or at least the only certainty, is our consciousness, or the aggregate of our mental states, and that we have no knowledge of things in themselves, we shall only be repeating the theories of Berkeley, Hume, Tracy, Kant, Bain, Mill, and almost all modern thinkers, as well as of the old Skeptics. (See Bain's Mental Science, book ii, chap. viii; Kant's Pure Reason, "Esthetic"; Tracy, Idéologie, tome iv; Hume's Human Nature, etc. Tracy is one of the ablest expounders of this doctrine. Some of his views are quoted and approved by Bain in Emotions and Will, *fin.*)

We look in vain for any new *facts* in Prof. Ostwald's article; and apart from a few hints, as a passing notice of electrical phenomena, his real *scientific* argument against the mechanical theory is the irreversibility of the phenomenal world, in contrast with the reversibility of the mathematico-mechanical formulas purporting to represent the former (page 595). Without stopping to show that his interpretation of mathematical formulas is entirely inadequate, that there is nothing intrinsically impossible in the reversibility of natural phenomena, and that his argument applies to "energistics" as well as to the mechanical theory, since the mechanical formulas have nothing to do with "matter," but with energy (mass being defined in terms of force—Rankine's Applied Mechanics, sec. 521), I shall again have to say that the professor is here repeating the law of the Dissipation of Energy, deduced by Sir William Thomson from thermodynamical principles; a consequence of said law being a constant loss of the *availability* of energy and a tendency to universal equilibrium. This law has been further generalized by Prof. Delbœuf into "the law of the fixation of force," according to which no force, after being transmuted into another, can restore *itself* to its original form. Here are some of his statements: "Tout changement a pour effet de faire passer la force de l'état transformable à l'état intrans-

formable; il consomme donc de la transformabilité. . . . La fixation d'une force libre n'est autre chose que sa combinaison avec une autre force qui par là aliène comme elle une partie de sa liberté." Although there is a tendency toward equilibrium, equilibrium will never be reached, " parce que la vitesse avec laquelle se fait le nivellement est une fonction directe de la différence même des niveaux." He also insists on the absurdity of a tree retrograding into a seed, an old man into a child, etc. (See Revue philosophique, 1880, 1882.)

Yours very respectfully,

ANTONIO LLANO.

419 ST. NICHOLAS AVENUE, NEW YORK, *March* 16, 1896.

Editor's Table.

PATRIOTISM AND MILITARISM.

PATRIOTISM is one of those virtues which have suffered so much from counterfeit and alloy that the word has come to have a very doubtful sound to experienced ears. So seriously, indeed, has it been damaged that one would in general prefer to use some other term to convey whatever respectable meaning it has hitherto covered. To a large section of the community, there is too much reason to fear, patriotism means little else than a vicious hatred of other countries, in so far as they come into any kind of rivalry or competition with our own. It stands for noisy, offensive, and vulgar national self-glorification, for truculence in the discussion of international questions, and a readiness to cast justice to the winds in any transaction with a foreign state. Patriotism of this type commends itself only too readily to boyhood with its as yet undeveloped moral sentiments, and therefore to adopt any special measures for inculcating it on the youthful citizen is, to say the least, most unnecessary. The true view of patriotism embraces none of the elements mentioned. To be a patriot a man does not need to hate or despise foreign nations; he does not need to indulge in vainglorious language, or even in vainglorious thoughts in regard to his own country; nor does he require to cultivate an insensibility to justice in regard to any international dispute in which his country may be engaged. Patriotism in the true sense implies simply such a love for one's country as inclines to disinterested service at all times and under all circumstances — a love which does not need the stimulus of quarrel with a foreign state to call it into activity.

To get a true measure and comprehension of the subject we should compare patriotism with certain other recognized virtues. The father of a family owes love and protection to his family. What should we think, then, of the father who, neglecting or even abusing his family at other times, showed his paternal feeling chiefly in espousing their quarrels, just or unjust, with other families, and greedily embracing every opportunity thus afforded for acts of hostility to his neighbors? We could only say that he was a man of a very low type, whose actions were mainly determined and governed by hatred and malice. Quite in the same way we are entitled to judge the citizen's love for his country, not by the blindness of his partisanship in questions in which his country is involved, nor by the rancor he displays in speaking or writing of foreign states, but by the interest he takes at other times, and at all times, in his coun-

try's welfare, and the service he renders to the cause of good government, and the general amelioration of the social and political life of the nation. We think it will in general be found that the citizen who is earnestly engaged in useful social work, and whose ordinary course of life affords an example worthy of imitation, will not be a patriot of the malignant type. His voice will not be cast for war on trivial occasions, nor will he take a ferocious delight in thinking of the disasters and humiliations which his country could inflict on a foreign foe. The man who truly loves his own country will find it impossible to hate any other. The good father of a family is a man who can be counted on for friendly offices beyond the limits of his family. He enters into the feelings of other fathers, and considers family life in general a sacred thing. So with the man who has a true feeling of devotion to his own country: he learns through it to love humanity at large.

Who, then, is likely to be what we have called the malignant patriot? The spoilsman makes a good one. Living as he does on the corruption of politics, the least he can do is to shout for the flag, and pour contempt on foreigners on every occasion, suitable or unsuitable. If he did not thus protest his love for his native land, people might think he was a parasite or saprophyte pure and simple; but thus he makes an effort, which we may take for what it is worth, to redeem his character. And with the spoilsman we find, vociferous for war and cynically indifferent to justice and humanity, a large body of individuals who, without being spoilsmen in the full political sense, are spoilsmen in a general everyday sense, in that they live by arts more or less inimical to the general welfare. These have no sense of organic union with the community, and the expression of hatred toward other nations affords them an emotional outlet which they could ill spare. Then we have the considerable number of those who, though they may, in their way, be tolerably useful citizens, are persons whose moral and intellectual natures are but poorly developed, and who perhaps sincerely think that hatred of the foreigner is at least a function of love of one's own fellow-citizens. These constitute a class of whom, perhaps, better might be made, but who in the meantime raise their voices very vigorously and inconsiderately for every aggressive foreign policy which mischief-making demagogues may suggest.

If patriotism in the true sense were more common throughout the civilized world, wars would cease, because patriotism would induce those reasonable, humane, and pacific feelings which are wholly opposed to injustice and aggression, whether practiced by individuals or by states. Unfortunately, the type of feeling which is most in evidence to-day is not patriotism, but militarism, a very different thing. The true patriot wishes his country to be in the right and to do the right in all international questions: the devotee of militarism wishes his country to be strong, so that, whether right or wrong, she may be able to impose her will upon others. It is not too much to say that the military spirit is fundamentally inconsistent with a love of justice for its own sake. It is a very tame business for enormous force to be always tied to exact rules of right; the temptation is almost overwhelmingly strong to blow right some fine day from the mouth of an eight-inch gun, and so set the war fiends dancing. The nation that sets out to have enormous armaments does not

thereby intimate to the world, nor yet to its own citizens, its desire and intention to be always in the right, to pursue undeviatingly the path of justice, but a desire and intention to be able to pursue whatever course may be indicated by national ambition. No one can doubt that in our own country the disposition to trust to right in our dealings with other nations has been growing feebler just as our armaments have been growing stronger. Every new battleship makes it a matter of less account—in the eyes of a large part of the nation at least—that we should be in the right at all. By and by, if things advance much further in the same direction, national honor will be held to demand that we commit some great wrong, and prove at the cannon's mouth that we are able to stand by it.

We confess that this is not what we were hoping for. Some twenty or twenty-five years ago, when the minds of our people seemed turning in the direction of a sound philosophy, we were very far from anticipating that at this date there would be a recrudescence of the spirit which derides philosophy and enthrones brute force in its place. We feel like asking what our schools and universities have been doing all this time. Have they been teaching our youth that, in the matter of citizenship, the highest honor any man can enjoy is to belong to a state whose respect for itself binds it to respect for others, and whose aim is far more to show the possibilities of civilized life at home than to make an imposing display of strength abroad? Do they teach that, if a nation can, without sacrifice of honor or betrayal of the just interests of its citizens, live at peace with all the world, it is its bounden duty, both for its own sake and as an example to mankind, to do so? Do they teach that war and liberty are essentially antagonistic, and that, only by parting with a large share of domestic liberty, can any nation take its place among the great fighting powers of the world? We fear that, whatever has been done in the way of inculcating these truths, the instruction has been far from adequate. At the same time it is satisfactory to note that, so far as men of scholarship and learning have spoken in the recent discussions of international questions, their voices have almost uniformly been raised on behalf of wide, humane, and reasonable views of national policy.

It was with special pleasure that we noted not long ago a "Symposium on Patriotism in the Public Schools" in the Interstate School Review, of Chicago, in which some excellent sentiments were expressed. One writer, U. J. Hoffman, says: "Let children study the lives of patriots, let them read the thoughts of patriots, such as Hawthorne, Bryant, Longfellow, and love of our native land will take care of itself. The requirement of the flag law, that the flag shall float every day, has caused the purpose of the law to be defeated." Another, William D. Kelley, says most excellently: "In our selection of subjects for hero worship we need not choose war heroes rather than those who are eminent in the acts of peace and charity. The man who stands up resolutely in the common council or the town meeting for what is right and against what is corrupt and wrong, is a patriot, and often a hero, and may be made as truly an example for children as those far removed from them in time, and whose fame is national or world-wide. The teacher should show that governments can commit sins as well as individuals. I would teach a love for the Revolutionary principles and a dislike for our

country's attitude in the Mexican War." A third writer, A. Califf, says: "I believe in teaching patriotism, but I do not believe in trying to legislate patriotism into people. I consider the 'flag law' a total failure, so far as the teaching of patriotism is concerned." A fourth, M. W. Marvin, gets to the root of the matter in the observation that "the teaching which tends to develop properly the pupil's sense of right and wrong, of humanity and justice, that which makes him better acquainted with his duty to himself, his neighbor, and his country, better prepares him for the future duties of a patriotic citizen."

If the teaching given in our schools and other educational institutions on the subject of patriotism were all on these lines, there would be nothing to complain of; on the contrary, there would be much cause for congratulation, and much reason to hope for good results at no distant day. Unfortunately, what with flag laws and other nonsense, it is difficult for the schools in some of our States not to be made subservient to the spirit and aims of militarism; and if the mind of youth is thus perverted, what will the harvest be? These are times when well-disposed citizens should take earnest and frequent counsel together as to the best means to antagonize the hurtful influences that are abroad, and to uphold the ideal of peaceful civilization as the true goal of national progress.

THE RÖNTGEN RAY.

PROF. RÖNTGEN'S discovery of the X ray crowns two as alluring courses of investigation as ever called forth the resources of experimental skill. One of the pillars from which sprang the achievement of the Bavarian teacher rose from the observation by an Italian cobbler, Vincenzo Cascariolo, who three hundred years ago picked up near Bologna a bit of sulphate of barium. It might, he hoped, have some value in alchemy, for it glowed in the dark as if with sunshine it had stored by day. This singular property of phosphorescence has since been noted in a wide diversity of minerals, in nasturtium and other blossoms, in fungi and decayed wood, in a host of flying and creeping things of kin to the common firefly and glow-worm. As means of detection are refined, it becomes more and more probable that phosphorescence, while highly characteristic of but a few substances, really manifests itself in matter of all kinds. In this it may share the universality of many other properties.

And phosphorescence, half a century ago, was discovered in direct alliance with other curious qualities. Of high importance was the discovery, in which Prof. Stokes took an honored part, that rays which enter the eye only to prove it blind can be brought within the compass of vision if suitably modified; that when ultra-violet rays of the spectrum traverse solutions of sulphate of quinine and other compounds, or take their way through uranium glass, they are so reduced in refrangibility as to fall within the range of perception. The light thus indirectly brought to view is fluorescence, the continuous phase of what in brief and fitful gleams is phosphorescence. Among the compounds fluorescent in an eminent degree is the platinocyanide of that same barium whose sulphate aroused the wonder of the Bologna cobbler.

While one group of explorers was running down the facts of phosphorescence and fluorescence, another group was examining the behavior of attenuated gases when excited by electricity of high tension. The familiar tubes of Geissler now shone with a radiance resembling the au-

rora of the northern sky. After Geissler came Prof. Crookes, and other physicists, who varied their queries in many ingenious ways. They replaced air with other gases, they brought exhaustion to a close approach to perfection, they changed the forms of tubes, the material of the electrode or current carriers, they increased and diminished the intensity of the electric discharge. Most significant of all, they placed fluorescent substances in the tubes, and brought them to vivid radiance.

Now came the epoch-making experiments of Hertz, which demonstrated Maxwell's theory that light is an electro-magnetic phenomenon; that light and electricity move through the same medium and at the same rate. Incidentally, Hertz produced electric waves of new amplitudes, which readily took their way through wooden doors and stone walls. In his vacuum tubes, by their capacity to excite fluorescence, he found that cathode rays penetrated thin sheets of gold, copper, aluminum, and other metals, while, strange to say, they were arrested by the glass of the tube itself. Hertz had abundant reason to think that, given a concordant ray, any substance whatever offers it a free and open path. His researches, cut short by his lamented death, were continued by his assistant, Prof. Paul Lenard, who inserted in the wall of a vacuum tube a tiny window of aluminum. Through this window he succeeded in bringing a cathode ray into the outer air for a distance of some three inches. This ray had all the characteristic tokens of light; it was capable of reflection, refraction, and polarization; it excited fluorescence; it had photographic power.

At this point Prof. Röntgen comes upon the scene, repeats the experiments of Prof. Lenard, and, by such a stroke of good fortune as befalls only the man who earns it, he incloses an excited vacuum tube in blackened cardboard treated with barium platinocyanide. To his delight he discovers that the cathode beam is accompanied by a radiance hitherto unknown, which, although of fluorescent and photographic quality, can scarcely be any form of light. It is not susceptible of refraction or polarization; indeed, it seems as if it might be a stream of infinitesimal particles, since its path is less impeded in a light metal, aluminum, than in a dense one, such as platinum.

Thus culminate the experiments of two companies of students—those devoted to inquiry regarding phosphorescence, and fluorescence and those who investigated the conduct of attenuated gases excited by electricity in vacua. It was many a weary day before the explorers came within sight of each other, before they could join hands on the common ground where all research meets at last in Nature's fundamental unity. At every step but the final one, the observer intent solely on "results" might well have asked, "What's the good?" And yet results of profound import to science and art lay bound up in quests not to be suspected of the most averted wooing of utility. The eye and its wonderful supplement, the photographic plate, now find disclosed what had been deemed forever hidden from sight and light. The physician and the surgeon rejoice in new powers of relieving pain and saving life. The physicist enlarges his conceptions of both matter and energy; he explores by a new path the mazes of molecular structure and motion. Once more it is emphasized that Truth is won only by her disinterested lovers, who, nevertheless, ever find her dowered with wealth greater than fortune-hunter ever dared pursue.

In practical applications of the Röntgen ray America is taking a leading part. But is it to her credit that here, as in so many other cases, she should be willing to have the pioneer work of science performed abroad? Do the planters and waterers of American universities fully realize that if there is to be applied science there must first of all be science to apply, that original research has the first claim upon their regard? "There is that scattereth and yet increaseth; and there is that withholdeth more than is meet, but it tendeth to poverty."

REGENERATION AND SCIENTIFIC ETHICS.

NORDAU has been answered. An anonymous author has done it in a book entitled Regeneration.* This champion declares pretty nearly everything sound which Nordau finds degenerate, and charges Nordau himself with German, philistine, and irreligious bias, though conceding "value as telling factors in the development of our race" to him and his work. With this critic's discussion of literary and artistic matters we will not concern ourselves; but he has one chapter, or, more accurately, a chapter heading, which we hope will not be taken too seriously. This is The Bankruptcy of Science. The charge that science is bankrupt—that it has not redeemed its promises—arose with the French symbolists. In his examination of these writers Nordau repels the charge, and cites a considerable list of scientific achievements as evidence of the solvency of science. Our author does not find this conclusive; for, he says: "The promises which the symbolists refer to as being dishonored by science are not of the kind that could possibly be redeemed by the achievements referred to in Nordau's splendid list. They allude to promises not really made by science, but by rash and prejudiced scientists." In other words, these promises are forgeries, and any one who would call science bankrupt because of its inability to redeem all the forgeries made in its name must be degenerate indeed. The fact that such fraudulent promises have been made and accepted, and of sufficient numbers and face value to attract attention, is really as impressive a testimony to the high standing of science as anything that Dr. Nordau has advanced in its behalf. No knave is ever fool enough to forge large drafts upon a concern that has not proved its ability to meet heavy obligations.

Our author next tells what these unauthorized promises were—that science was to furnish substitutes for religion and morality and to lead the human race into an ideal mode of life—and goes on through a dozen pages charging evil consequences to their nonfulfillment, and denouncing the scientists who made them. Although he says all this under the heading The Bankruptcy of Science, he is careful everywhere not to charge the dishonored promises in question to science itself, but to the "rash and prejudiced scientists," before mentioned, with whom he declares Nordau to be in sympathy. Our author's aggressive chapter heading is, therefore, merely a convenient phrase borrowed from the symbolists, and he is guilty of a petty deceit in using it without quotation marks or other qualification over pages which do not prove nor even charge bankruptcy against science itself.

In discussing the promises of the "rash and prejudiced scientists,"

* London: Archibald Constable & Co.; New York: G. P. Putnam's Sons.

which he does at length and with much vigor, our author shows that he can not or will not understand the ethics which the scientists are developing. He says: "As to morality, the religion of humanity seemed extremely untrustworthy; for the removal of all personal responsibility, and the certainty of complete annihilation after death, seemed to give the strong-minded and clever people the strongest possible inducement to make their fellow-beings tools for their own happiness." Going on, he draws a dreadful picture of the effect which the ethics of the scientists has produced upon ordinary mortals who, "caring little for what would happen to the next generation, or still less to generations thousands of years hence," have lived for self-gratification. He returns to this subject in a later chapter and instances "the case of a poor laborer who, in the usual course, will work and suffer during his whole life and die in poverty. To escape such a destiny," says our author, "many roads are open to him if he have courage, exceptional ability, and no belief in a hereafter. . . . He might even avoid violent and vulgar crimes and operate in a safer manner. He might blackmail a rich man. . . . He might turn first a usurer, then a financier. He might keep a degrading public house or a gigantic immoral place of amusement. He might issue a debasing newspaper, write corrupting books and dramatic pieces." A careful revision of his manuscript or a sense of humor, such as he denies to Max Nordau, ought to have shown our author that he has here created an impossible character. A "poor laborer" with the "courage" and "exceptional ability" to do any one of these things, would not "in the usual course work and suffer during his whole life and die in poverty." He could secure ease and a competency in many an entirely moral calling.

We feel well enough acquainted with the ethics of the scientists which our author denounces to say that one of its cardinal principles is the inevitable sequence of cause and effect. From this law it follows that no one can do evil without evil being returned. Circumstances may postpone the effects of his acts until after his death, but he can never count on this, and every one sees cases in which the reaction is swift and terrible. Even if he were sure that the consequences of his evil deeds would be borne mainly or wholly by the next generation, there would still be a restraining influence upon him. How can a more agonizing punishment be inflicted upon a mother than through her children, or a stronger appeal be addressed to her than one for their welfare? And it is a question whether the love of a father for his offspring is not as strong as that of a mother, even if less intense. But aside from ties of blood we do care for those who are to survive or come after us. The conduct and labors of many a person have been avowedly governed by the desire that men should speak well of him after his death. Countless lives have been heroically sacrificed through devotion to fellow-creatures or native land, perhaps mingled with a wild delight in conquering obstacles, but without thought of reward hereafter.

The central idea of the ethics of the scientists, as we understand it, is conformity to the order of the universe. Any one who violates this order in his relations to his fellow-men is just as sure of provoking a punitive reaction as when he comes in conflict with the law of gravitation. This truth would be more evident if scientific ethics were more generally taken as a guide. The

only reason why the man whom our author supposes as preying upon his fellows can be presumed to succeed at all in his career is that he would be alone in a community which had a different moral code. If we suppose him to be surrounded by men like himself, as many depredations would be committed upon him as he committed upon others, and he would quickly abandon his policy as unprofitable. To accept the dictum that nothing but a belief in reward or punishment after death can keep a man from taking every possible advantage of his fellows is to put human beings lower than the beasts. It is not a hope of immortal happiness that causes ants of the same colony or bees of the same swarm to be just, considerate, and even generous toward one another, that constrains the old males of herbivorous quadrupeds to stand guard over the rest of the herd, or that makes it practicable for certain carnivores to hunt in packs. Experience, individual or inherited, has given them a controlling sense of what conduct pays best in the long run. Those creatures which do not co-operate in communities are yet far from trespassing upon others of the same species in the manner of our author's "poor laborer." If the beasts can perceive so much of the order of the universe as to keep their conduct from becoming unduly egoistic, is not man capable of learning the same lesson? The ethics of the scientists is far from being such an empty husk as our author represents. It is imperfect, to be sure, but can a complete solution of so great a problem be expected in a few short years? Moreover, some allowance for any partial failure that may be observed in its application should be made on account of the frailty of human nature and the disturbing influence of unsympathetic associates.

Nordau being one of the scientists who upholds the new ethical theory must, his critic thinks, have a bias against the adherents of revealed religion. The critic claims to find evidence of such a bias in Nordau's book, and a large part of his criticism is based upon this claim. Regeneration is largely an effort to impeach the fairness of Nordau's judgment, and to discredit his diagnosis by an appeal to religious prejudice. As such it should be estimated.

Scientific Literature.

SPECIAL BOOKS.

Dr. *A. F. Chamberlain* has chosen for a folklore study a field made doubly attractive by the newly aroused interest in the psychology of the child.* Truly he has garnered an abundant harvest. It would be difficult to think of any activity or relation of children that is not represented in the thirty-three chapters in which he has arranged his material. From the cry that it utters and the more or less ceremonial care that it receives on its entrance into the world up to its admission to the society of adults, each phase of childish thought or action and of parental care has its wealth of customs and sayings. Thus Dr. Chamberlain tells us, on the authority of

* The Child and Childhood in Folk-thought. By Alexander Francis Chamberlain. Pp. 464, 8vo. London and New York: Macmillan & Co. Price, $3.

Boas, that Songish and Nootka Indian mothers press and rub certain parts of the newborn infant's body in order to give it the shape that they deem beautiful. Many are the modes of expressing affection for children among different peoples, but it seems strange to find under this head the custom of burying a live infant with the mother who has died in giving it birth, for the practice often has an element of vindictiveness. There is a considerable mythology connected with childhood, including lore about guardian spirits and bogeys, also the myths made to answer children's questions as to where the latest addition to the family came from. The folklore connecting children with plants and with animals is an especially delightful branch of the subject. The firstborn child becomes a social factor among some peoples the moment it sees the light, for its birth changes the status of its parents in the community. Its rights of heritage, etc., and the marriage that is contracted for it in its early years among some peoples—even in England in the sixteenth century—are other features of its social importance. At school and in the societies, secret or open, which they form among themselves, including the street gangs of large cities, children reveal the traits that are brought out only by close association with one's equals. The efforts of the child in learning and making language, and as an actor, inventor, poet, musician, and judge, afford an instructive insight into his mind, while his elevation to the position of oracle, weather-maker, healer, priest, hero, and deity shows us the adult mind of many primitive peoples. This volume is not absolutely restricted to lore in which the child is the central figure; thus three of the early chapters are devoted to motherhood and fatherhood, while legends about the origin of certain peoples and the admission of women to the priesthood among others have no obvious connection with childhood. The author gives us a bibliography of five hundred and forty-nine titles, and, with few exceptions, his lore and legends are referred to this list by volume and page. One of the evils attending the great benefits that have been derived by Americans from the study of German authorities is the practice of dividing indexes that is beginning to creep into American books. In this respect Dr. Chamberlain out-Germans the Germans. His collection of child-lore proverbs (which is a feature of the book worthy of special mention) has two indexes—one of the peoples, the other of the authors, from which they are drawn; his bibliography, which follows these, is divided into three classes, each arranged in a separate alphabet by authors, and each followed by an independent subject index; then comes the general index to the volume, the entries of which are divided into three classes, each arranged in its own alphabet. Obviously the user must spend more time in getting at the right subdivision of such lists than in finding his reference. But in spite of this systematic confusion at the end there is not a dry page in the book nor one without scientific value.

The art of depicting the successive positions passed through by animals and other bodies in motion, which aroused much public interest a few years ago, has not been allowed to stand still since that time. Great advances in processes and execution have been made and more difficult problems have been solved, so that the results which M. *Marey* is now able to present to the public are remarkable for their range and definiteness.* The camera

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* Movement. By E. J. Marey. International Scientific Series, No. 73. Pp. 323, 12mo. London: William Heineman. Price, 7*s.* 6*d.* New York: D. Appleton & Co. Price, $1.75.

used by him for chronophotography, as he calls this art, has for its chief peculiarity two circular diaphragms behind the object glass which revolve in opposite directions. There are openings in these disks, and when two of them come opposite the lens there is a momentary exposure of the photographic plate. With suitable accessories, including a specially constructed tank, the same apparatus is used for photographing the movements of aquatic creatures and the motion of waves. When it is desired to take a large number of images per second the apparatus must be modified so as to use a moving film instead of a fixed plate, and for photographing free birds and some other objects whose motion can not be controlled, the photographic gun is employed with the film. In the volume before us the author describes the results he has obtained with these forms of apparatus in recording the movements of man, the horse, birds, fish, starfish, jellyfish, reptiles, the crawling and flying of insects, the squirm of the eel, and the pollywog's wiggle. The methods that have been devised for meeting special difficulties are remarkably ingenious. Thus, when the movements of a running man are to be pictured at such short intervals that the successive images would be partly superposed and hence give a confused picture, the subject is dressed in black with white marks on the head, arm, and leg. The result, which consists of images of these marks only, suggests the march of a file of skeletons at the double quick, and can be very readily studied. After the same manner the trajectory of an insect's wing is sometimes made visible by gilding its tip, or that of a crow's wing by affixing a bit of white paper to the end of one of the feathers. Chronophotography has also been applied to experimental physiology, and M. Marey gives us a series of pictures representing the movements of the heart of a tortoise under artificial circulation. Moreover, movements visible only under the microscope can be pictured by this process, but only a beginning has been made in the latter field. The volume appears in the familiar form of the International Series, and is illustrated with over two hundred figures.

One who would know the birds of Britain can hardly do better than allow himself to be introduced to them by Mr. *Hudson*.* This author writes for the general reader and the amateur rather than the ornithologist; hence he gives the coloring and size of each species in from three to six lines, and follows this with a popular description of its feeding and nesting, habits, song, etc. He describes all the species that reside permanently, or for a portion of each year, within the limits of the British Islands, and takes pains to distinguish from these the occasional visitors and the stragglers, to which he gives only brief mention. In his descriptions, especially of song, he frequently quotes John Burroughs, with whom he generally finds himself in agreement. But though the book is untechnical, let no one suppose that it is unscientific. The species are grouped by orders, and follow the arrangement of the British Ornithologists' Union. There is also a chapter on the structure and classification of birds, by Frank E. Beddard. The illustrations of the volume deserve especial mention. There are, first, eight colored plates, from original drawings by A. Thorburn, representing the golden eagle, bearded titmouse, goldfinch, bittern, common teal, ptarmi-

* British Birds. By W. H. Hudson. Pp. 363, crown 8vo. London and New York: Longmans Green & Co. Price, 12*s*. 6*d*., $3.50.

gan, dotterel, and roseate tern; there are also eight plates and one hundred figures in black and white from original drawings, by G. E. Lodge, and three illustrations from photographs from Nature by R. B. Lodge. The execution of both illustrations and letterpress is excellent. It is perhaps too much to expect immaculate diction as well as scientific accuracy and a pleasing style in the same writer, but it does seem that a second thought would have prevented Mr. Hudson from saying, "The food of the cuckoo is exclusively insectivorous."

GENERAL NOTICES.

Dr. *Ostwald* has again laid the chemists of the world under obligations to him by a helpful discussion of the principles underlying a department of their science.* Feeling that the scientific side of analytical chemistry had been left too far behind by the technique of the subject, he has undertaken to make available recent advances in chemical theory that are capable of throwing much light upon the processes of the analytical laboratory. The author points out that for the recognition of a substance only a few of its properties need be ascertained, for if the substance under examination agrees perfectly in some of its properties with a known substance, it will agree in all. It usually happens that we have a mixture of substances to examine, and the separation of these must precede their recognition. He next shows that separation is a mechanical operation and usually depends on transforming one substance after another into a different state of aggregation from the rest of a mixture. Chemical separation consists in such transformations, and is hence really a preparation for mechanical separation. In treating these processes the author discusses the theory of solution, an important law of which is that salts do not exist as such in aqueous solution, but are dissociated more or less completely into their constituents or ions. Other laws concerned in chemical separation are those of chemical equilibrium, the course of chemical reactions, precipitation, and those governing reactions attended with the liberation or absorption of gas and reactions accompanying the extraction of a dissolved substance from one solvent by means of another. To this chapter the author has added a section on electrolytic separation. Dr. Ostwald touches upon the measurement of the quantity of a substance that has been separated and recognized, or quantitative analysis, and then passes to the application of the laws just enunciated. This part of the work is arranged according to the usual analytic groups, and the behavior with reference to their ionic state of the substances treated is made especially prominent. The author holds that "if we adhere constantly to the point of view that analytical reactions are with very few exceptions *reactions of ions*, then a review of the facts of analytical chemistry becomes at once infinitely simpler."

* The Scientific Foundations of Analytical Chemistry. By Wilhelm Ostwald. Pp. 207, 12mo. London and New York: Macmillan & Co. Price, 5*s*. net, $1.60.

One of the latest additions to the Library of Useful Stories is a popular sketch of geology.* The author first calls attention to the earth's internal heat and to its effects in producing the rocks of mountains and volcanoes. He then shows how the materials of stratified rocks are produced and laid down and what a variety of fossil vegetable and animal forms are included in them. This brings him to the descriptions of the successive geological formations, from the Archæan to the gravels, which occupy the rest of the volume. The aim of the author has been "to tell the story of the Earth so that its past history helps to explain its present condition." To this end he constantly points out how familiar appearances result from the processes which he is describing, and he also draws especial attention to the information which fossils give us con-

* The Story of the Earth in Past Ages. By H. G. Seeley, F. R. S. Pp. 186, 24mo. London: George Newnes, Ltd. Price, 1*s*. New York: D. Appleton & Co. Price, 40 cents.

cerning the rocks in which they are found. The text is illustrated with forty cuts.

The inscription on the back of a volume before us is a most unfortunate one,* for if the student does not take the trouble to look between the covers he is led to believe that the book is an extensive monograph on *Peripatus*, with forms closely related to this extraordinary animal. If he passes it in consequence of this misleading title, he will have missed an exceedingly condensed and clear account of the external features, habits, and anatomy of *Peripatus* by Mr. Sedgwick, filling twenty-six pages; a most valuable chapter of fifty pages on the *Myriapoda*, by F. G. Sinclair; and another chapter on the orders *Aptera*, *Orthoptera*, *Neuroptera*, and *Hymenoptera*, by David Sharp, of five hundred pages! As the other orders of *Insecta* are to be dealt with in Volume VI of this series, one wonders what the lettering on the back of Volume VI will be—possibly *Peripatus*, etc., by Sedgwick, see Volume V, or, as it will begin with the *Coleoptera*, some low and aberrant form will be selected, and on the back the comprehensive title *Stylops*, etc., will stand for the great orders *Coleoptera*, *Lepidoptera*, *Diptera*, and *Hemiptera!* With this criticism, we can only say that the book upholds the reputation already established for the series. The illustrations are many and beautiful, the descriptions and grouping of the material clear, and the work an indispensable one to the general student of this great class of animals.

In two text-books on zoölogy recently received provision is made for two modes of instruction. In the one † the scientific method of acquiring knowledge of natural history—through field study and laboratory work—is consistently carried out. A comparatively small number of typical forms (thirty-two), ranging from the amœba to the rabbit, are chosen for study, all being such as may be easily obtained at inland points as well as near the sea. The chapter on insects shows the method of the book. It begins with directions for collecting specimens. The sulphur butterfly is the first species to be studied, and enough of its characteristics are given to enable the student to recognize it. He is directed to collect specimens for study, and while collecting to observe such things as the kind of flowers on which they are found feeding, whether they feed on the wing or not, the organ used in obtaining food, its position when in use and when not in use, its shape and length. Other observations are to be made on a specimen liberated indoors before a closed window. The study is continued with dead specimens. At the end of the chapter on insects is a general account of the life process in this group of creatures. This is followed by a review exercise which involves considerable observation, and after this a lesson in classification is given. An appendix contains lists of books and reagents, full directions for obtaining and preparing material for study, a glossary, etc. There are one or more illustrations for each species studied.

Recognizing the fact that in many large schools, especially in cities, it is impossible to secure provision for either laboratory work or field excursions by classes, Miss *Burnet* has aimed to provide as good a substitute as may be in book form.* Not being limited to animals everywhere procurable, she ranges through the whole kingdom from amœba to man, and gives brief descriptions of a large number of species, including many salt-water dwellers. Independent collecting by the pupil is encouraged to supply the deficiencies of text-book study, directions for taking specimens and preparing them for the cabinet being given in some detail. There are one hundred and ninety-seven illustrations.

The author of this book,† to whom the original structure of the universe has long been a favorite subject of study, has here presented a modified form of the nebular theory of Laplace, based on certain calculations and new ideas of his own. As a starting point, he suggests the possibility of a more attenuated form of matter than we

* The Cambridge Natural History. Vol. V. Peripatus, etc. Sedgwick. Macmillan & Co.

† Elementary Lessons in Zoölogy. By James G. Needham. Pp. 302, 12mo. New York: American Book Co. Price, 90 cents.

* Zoölogy for High Schools and Academies. By Margaretta Burnet. Pp. 216, 12mo. New York: American Book Co. Price, 75 cents.

† Notes on the Nebular Theory. By William Ford Stanley. Pp. 259, 8vo. London: Kegan Paul, Trench, Trübner & Co. Price, 9s.

conceive as nebula, consisting of particles smaller than the chemical atoms, and to this he gives the name "pneuma." He supposes the pneuma to consist not of a single nor a few elements, but of a much larger number than we now know—possibly exceeding ten thousand. He then goes on to describe how these particles might combine to form atoms and how an immense pneuma might condense to form a core around which revolved masses formed from rings that had been detached as the process advanced. In this, and in accounting for the rotation of the several members of such a system, he is not greatly at variance with current theories. His view of comets makes them quite regular members of a planetary system. In the more particular examination of the history and present condition of the earth, which follows, he suggests the possibility of some continental elevations being formed by the projection of cold planetoids upon the molten globe. The probable effect upon the condensing earth of the formation of the inferior planets is then discussed, and, in conclusion, an effort is made to correlate the geological periods, including the Glacial epoch, with astronomical phenomena. The author has read papers upon some of the topics discussed in this book before various learned societies in England. The volume is illustrated with several plates and small cuts.

Food Products of the World is the title of an interesting volume by *M. E. Green*, M. D. (Chicago, The Hotel World). The original intention of the author, who was one of the judges of food products at the Columbian Exposition in 1893, was simply to give an account of the foods there exhibited; but as the work progressed it was deemed desirable to expand the treatment somewhat and make a popular treatise, which should in a fairly thorough manner cover the whole subject. Each food stuff is first treated in a general way. Its history, preparation, cooking, and keeping qualities; its habitat, if animal or vegetable; and, finally, the chemical composition and dietetic value, are given.

Since the appearance of the first edition of this work, *Sedgwick and Wilson's Introduction to General Biology* (Holt, $1.75), in 1886, the original intention of the authors, to publish a second volume which was to form the main body of the work, and to include the study of a series of type forms, has been abandoned. The present volume, in consequence of this, differs in several particulars from the first edition. The introduction has been extended so as to include representatives of the unicellular organisms, *amœba*, *infusoria*, *protococcus*, *yeasts*, *bacteria*. The study of the animal is placed before that of the plant, and the laboratory directions, which occur in the first edition, having been found unsuitable, are omitted. The general subject matter has been revised and many additions made, especially on the physiological side.

We are convinced from an examination of the text-book on *Organic Chemistry: the Fatty Compounds*, by *R. Lloyd Whiteley* (Longmans, 3*s*. 6*d*.—$1), that its author possesses a high degree of the teaching faculty. He seems to build up a knowledge of the carbon compounds in the student's mind by starting with a few general ideas and adding others in the order and manner in which they can be best assimilated. He is careful also to distinguish what is demonstrable experimentally from what is obtained by reasoning or is assumed as a means of expressing empirical results. He is concise, too, managing to describe in a small volume the fatty hydrocarbons, haloid paraffins, monohydric alcohols and their several classes of derivatives, the cyanogen and carbonic-acid derivatives, the derivatives of unsaturated hydrocarbons, and the dihydric and polyhydric alcohols and their derivatives. Processes for the preparation of a large number of compounds are given, a distinguishing mark being placed against those most suitable for students' work. Commercial processes for producing the most important substances are outlined. There are forty-five cuts, nearly all of laboratory apparatus.

In *Essentials of Vegetable Pharmacognosy* the gross structure of plants is set forth by *Henry H. Rusby*, M. D., and their minute structure by *Smith E. Jelliffe*, M. D. (Haynes, New York). The former monograph begins with the structure of the flower, and passes on to its functions and the production of fruit. The root, stem, and leaf are then considered in succession, after which phyllotaxy and anthotaxy are discussed. The treat-

ment is full but condensed, and no effort has been made to avoid technical terms. The second portion of the work is prefaced by descriptions of various simple magnifiers and of the compound microscope. The structure and contents of the plant cell are then described, after which the tissues, grouped according to function, receive attention. The volume is designed mainly for students of pharmacy and medicine, and both parts are fully illustrated.

The *Bulletin of the Department of Labor*, a bimonthly publication authorized by the United States Congress, began with a number for November, 1895. The Bulletin is designed to present results of investigations by the department of less magnitude than those usually embodied in the annual or special reports, also digests of foreign and State labor reports, new State and national laws relating to labor, and brief items of interest. The first number contains a record of strikes and lockouts in the United States and other countries in recent years, a statement of private and public debt in the United States, a digest of recent reports of State labor bureaus, statistics of employment of women and girls in England and Wales, and a statement of the legal relations between employer and employee.

The Third Series of *Essays by Lady Cook on Social Topics* (Universal Publishing Co., London, 6*d.*) consists of thirteen essays pointing out the need of reforms in the relations between the sexes. In these papers Lady Cook advocates nothing unreasonable, while her mode of presentation is forcible, serious, and free from prolixity.

In two pamphlets—*Discussions on the Gypsies* and *Social Emancipation of the Gypsies*—an effort is made by *James Simson* to obtain better social recognition for this people and to prove that John Bunyan was one of their number (The Author, 43 Exchange Place, New York; 70 cents and 30 cents). Unfortunately, the author has neither the faculty for investigation nor the art of presenting a subject in proportion to his interest in the matters that he discusses.

The Report of the State Geological Survey of New Jersey for 1894 represents work in surface geology in both the northern and southern parts of the State. The areal work in the glaciated area was completed, and good progress was made in the region farther south, especially in the western part of the State—Mercer, Burlington, and Monmouth Counties. These areas were studied in much detail. A map accompanying the report—Geological Map of the Valley of the Passaic—indicates the extent of the work which has virtually been accomplished. It presents an instructive view of the geological features, streams, and towns. Further light is thrown by the results recorded concerning the considerable influence of stagnant ice upon the deposition of the stratified drift of the valleys of the northern part of the State, and the general position already taken concerning the history of the yellow gravel formations. Many facts of great interest are given concerning the artesian wells of southern New Jersey and the forestry of the State, to which the second and third parts of the report are devoted.

The *Revista della Beneficenza Pubblica delle Istituzioni di Providenza e di Igiene Sociale* (Review of State Philanthropic and Provident Institutions and of Social Welfare), Bologna and Rome, *Avvocate G. Scotti*, director, was started with the beginning of 1896. Besides general articles, it gives notices of the publications of benevolent institutions, social studies of the laboring classes, legal events, and official reports pertaining to subjects within the scope described by its title. The principal article in the January number is on True Beneficence and Legal Beneficence.

Il Pensiero Moderno is a new semi-monthly periodical published at Rome which will deal with all that concerns the modern sociological movement, and the fields of science, literature, and art. The name of Prof. G. Sergi stands at the head of its list of collaborators. The first number contains articles on social hygiene and education. A regular feature will be the fortnightly notes on the more important intellectual and social events within its scope.

We find matter of great interest and value in the *Ethnologisches Notizblatt* of the Direction of the Royal Museum für Völkerkunde in Berlin. The articles are mostly by the director, Dr. A. Bastian, and his assistants, Profs. A. Grünnedel and W. Grube,

and Drs. F. Von Luscher, W. Seler, F. W. K. Müller, and Wenle. In Heft 2 for 1895 we find papers on two old canoe-carvings from New Zealand, various anthropological objects from India, a Japanese picture of the world-mountain, Meru, a number of recent Siamese books and manuscripts, a collection of Chinese idols from Amoy, the latest crossing of Africa, the twenty-fifth annual meeting of the German Anthropological Society, the Siamese art work *Trai-Phum*, or Three Worlds, color studies, the report of our Ethnological Bureau, and a large number of notices of books, societies, etc., relating to anthropology.

A very elaborate examination of the development of Kant's philosophical system is presented in the *Kant-Studien* of Dr. *Erich Addickes* (Kiel and Leipsic: Lipsius and Fischer). In the first part of the essay, which is devoted to this subject specially, the course of the German theory of knowledge from Leibnitz to Kant is reviewed, with analyses of the systems of Leibnitz, Wolff and his followers, and Crusius, after which follow sections on Kant's original point of view, his so-called empiristic period, his conversion in the year 1769, and the inaugural dissertation and Kant's further development. The second part is on the period of the composition of the *Kritik* of Pure Reason.

A volume of *Chemical Experiments*, containing something over two hundred experiments, has been prepared by *Ira Remsen* and *Wyatt W. Randall* to accompany Prof. Remsen's Introduction to the Study of Chemistry (Holt, 50 cents). This laboratory manual includes the experiments in the last edition of the Introduction, minor changes having been made in many of them, and essential changes in a few. There have been also some additions.

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Fragments of Science.

Commerce and Drought.—The serious loss which a prolonged drought may cause, not simply to agriculture, but in an even more marked degree to commerce, is drawn attention to by Prof. L. M. Haupt, in a recent number of the Journal of the Franklin Institute. He says: "One of the most impressive lessons to be derived from the absence of sufficient water for commerce is to be found in the experience of the communities on the upper Ohio River during the past season of exceptional drought. The harbor of Pittsburg, which is made by the movable dam at Davis Island, and the fixed dams of the Monongahela slackwater system, forms a convenient basin in which to make up the tows of coal boats and barges which supply the Mississippi and its tributaries. It is the custom to assemble these tows above the dam and await the pleasure of Pluvius to provide a flood with sufficient depth of water to carry them out. During the past season there has been no coal shipped by river between the 18th of April and the 28th of November (over seven months), and the accumulation of the product had gone on until the tonnage tied up exceeded that of any harbor in the world. For miles on both banks of the river the steamers and their fleets lined the shores, and the danger of their being frozen in all winter was imminent, when a heavy rain released two hundred thousand tons; but a part of these met a watery grave on the shoals of Dead Man's Ripple, a short distance below Pittsburg. The extent of this congestion can not be appreciated by one who has not seen it, and it is far-reaching in its effects, as it directly concerns the industries of millions of people. The actual value of the plant tied up in the harbor of Pittsburg alone, as stated by Hon. John F. Dravo, Secretary of the Coal Exchange, on November 7, 1895, was $6,500,000. At the present time it is costing about two thousand dollars per day to keep this tonnage afloat, besides interest on the investment. This 'tie-up' of Nature has seriously crippled the entire valley, as the railroads can not do more than maintain a partial supply, and the price of fuel has risen in some of the larger cities one dollar a ton." The author cites the above incidents as showing

that a more liberal policy in spending public money for river and harbor improvements would, in the long run, be the most economical.

The Bamboo as a Food.—Young bamboo shoots are eaten by the Chinese and Japanese as we eat asparagus. Dr. Lamounier, who has a collection in his garden at Verneuil, France, tried two or three species at a right age, and found them excellent. The stalks should be taken very young during the first fortnight of spring growth, and should not be more than fifteen centimetres thick. The outer envelopes of spathes are taken off, and the soft substance is left, crisp and brittle, and yielding easily to the pressure of the finger. Dr. Lamounier says they have the general taste and flavor of Brussels sprouts, and that they are wholesome, easily digestible, and economical. But all depends on the time of cutting and the preparation. Some canned bamboo, exhibited by the Japanese at Paris in 1889, was found hard and flavorless. We have these differences, too, in asparagus and all vegetables, while we judge the quality of the same from their best, not from their worst.

Tuberculosis and Meat Inspection.—In a paper presented to the New York Academy of Medicine during last November, Prof. Leonard Pearson, of the University of Pennsylvania, gave a *résumé* of the recent work of foreign veterinarians on bovine tuberculosis. We take the following points from a reprint of the address in the Dietetic and Hygenic Gazette. "This subject," he says, "has been a live one in Europe for many years, and has received much attention ever since it was shown by Villimen, in 1868, that the disease could be transmitted from one animal to another, and more especially since the discovery of the tubercle bacillus by Koch in 1882 and the consequent establishment of the fact that the tuberculosis of men and the lower animals is the same disease and caused by the same germ. Most of the European countries now have a system of meat inspection, which is carried out most carefully in the great centers of population, and usually assures the consumer against harmful flesh. The question as to what shall be done with tuberculous carcasses has excited much discussion. There is practically unanimity regarding the immediate and entire destruction of the carcasses of animals that show generalized tuberculosis, or tuberculosis with marked emaciation, but the cases of localized tuberculosis are much more common, amounting in some places to fifteen or eighteen per cent of all cattle slaughtered. The careful experiments, however, of Chauveau, Nocard, Bollinger, Bang, and McFadyan have shown that the flesh of animals with local tuberculosis is not infectious. It has been shown, however, that if there are any tuberculous spots the butcher is likely to get infected material from this spot on his knife and spread it more or less generally over the carcass. At the International Veterinary Congress held last September in Berne, it was decided by resolution that the flesh of tuberculous animals should be condemned when the carcass is emaciated, when it has a general bad appearance, when tubercles are found in the muscular portions, and when alterations are found in several organs. It was also recommended, in relation to the flesh of slightly tuberculous animals, that it be permitted to go on the market, but that it be sold in special shops or stalls, or sterilized and sold as cooked meat. In Germany the practice is to condemn the worst cases, sterilize those that are less extensive, and to pass as sound the slightly developed cases, after destroying the affected parts. A very important point in connection with this subject is in reference to the payment of indemnity to the owner of the condemned animal or carcass. It is felt that, as the animal is condemned for the good of the public, they should bear part of the loss. Already in France it is the custom to compensate the owners of infected animals which are destroyed. The consideration of the milk from tuberculous cows is also of great importance. Numerous investigations have demonstrated that the milk of cows with tuberculosis of the udder will cause tuberculosis in a very large percentage of the animals fed upon it. Ostertag recommends that the milk from cows with tuberculosis of the udder should be excluded from consumption, and that from cows which react to tuberculin, but show no evidence of tuberculosis of the udder, should be sterilized before sale. In a recent report from the

Royal Commission on Tuberculosis in Animals the statement is made that 'the withdrawal from dairies of every cow that has any disease whatever of the udder would form some approach to security against the serious danger incurred by man from the use of tuberculous milk, but it would not be an adequate security.' The presence in a dairy of a tuberculous cow, the report says, is a decided source of danger to the public, especially having regard to what has been learned respecting the rapid development of tuberculosis of the udder. Regarding the value of tuberculin injections as a diagnostic agent, the following resolutions were adopted at the International Veterinary Congress held last September, and hence represent the opinions of the foremost veterinarians of Europe: 'No. 1. Tuberculin is a very valuable diagnostic agent and can yield the greatest assistance in combating tuberculosis. There is no reason for objecting to its general application on the ground that it may aggravate pre-existing tuberculous lesions. No. 2. The congress expresses the desire that governments shall order the employment of tuberculin in herds in which the existence of tuberculosis has been established.' The official veterinarians of Germany are advised to use tuberculin, and are supplied with it at a low cost from the government laboratories."

Tibetan Women.—As described by Mr. W. W. Rockhill, the Tibetan women are usually stouter than the men, with fuller faces, and do not entirely lose their good looks before they are thirty or thirty-five years old. They are as strong as or perhaps even stronger than the men, because, being obliged to do hard work from childhood, their muscles are more fully developed than those of the men, who do not carry water on their backs, work at the loom, or tend the cattle. Their hair is long and coarse, but not very thick; it remains black, or only mixed with a little white, to extreme old age; and both men and women with white hair are rarely seen. The skin of the Tibetan is coarse and greasy, light brown in color, frequently nearly white, except when exposed to the weather, when it becomes a dark brown, nearly the color of our American Indians. Rosy cheeks are common among the younger women. The Tibetans' voices are powerful, those of the men deep, those of the women full and not very shrill. Their hearing is good, and they can converse freely from one side of a valley to the other, a distance of half a mile, without ever having to repeat phrases or perceptibly raise the voice. They can endure exposure without any apparent inconvenience, the women doing their work with the right side of the body completely exposed, and small children going naked, or with only a pair of boots on, except in the coldest weather. They can also endure hunger, and are at all times small eaters.

A New Glass Construction.—We take the following from a report presented by Dr. Schott to the French Society for the Encouragement of National Industry: For siliceous glasses the expansion increases with the proportion of alkali. Boric acid produces a striking decrease of expansion. In superposing upon each other two glasses of different compositions, it is requisite that there should exist a certain relation between the relative thickness of the two layers of glass and their coefficients of expansion. Thus at Jena they solder normal thermometer glass, the coefficient of cubic expansion of which between 0° and 100° = 0·0000244, to an aluminous sodium borosilicate, the expansion of which = 0·0000177. The former kind of glass must be placed externally and the second internally in order to form a hollow vessel or tube. We may also join together three or more layers of two or more glasses. Of two layers of glass with different expansions after cooling, that with the greatest expansion will be in a state of tension and the other in a state of compression. External layers in a state of compression increase in a striking manner the resistance of glass to mechanical actions and to rapid changes of temperature. Flasks thus manufactured may be strongly heated (to a temperature of 184°), and may then be sprinkled with cold water without injury. Such glasses are not liable to the sudden rupture which is apt to occur in glass tempered by the process of De la Bastie.

An African Village Scene.—"I doubt," says Dr. D. Kerr-Cross, "if finer villages or better built houses exist anywhere in un-

civilized Africa than are found among the 'Wa-nyakyusa' people" of the district north of Lake Nyassa. Round houses are occupied by the married people, but they also build square houses and long cattle-folds. The walls are of bamboo set into the ground at an angle of about 100°. Small bricks about the size of an ostrich egg are fitted neatly, while plastic, into the framework. The whole is a huge basket of bamboo reeds and mud. The reeds on the roof are tied in wavy lines in the form of a dome, the thatch is laid with great skill, and the house is scrupulously clean. Large villages are uncommon, but on the plains one village is connected with another by banana groves which often extend for miles. Trees are planted for utility and for ornamentation, and are regarded with pride. There are no stockaded villages, but a kind of poisonous cactus is grown as a defense. All manual work in cultivation is done with giant hoes. Their fields look as if they had been deeply plowed, and every furrow is perfectly straight. They are a tall, muscular race, of few wants, desiring nothing of strangers. They appreciate cloth, but have little idea of its value. They are in what one might call the "brass-wire age." That is their medium of exchange, and anything can be bought for it. Iron is found in the King's Mountains, and is extensively wrought. They make iron, copper, and brass belts as thick as one's little finger, and wear them on the waist. Six or more of such belts may be worn on the person of one individual. Their word for riches means iron. The Nkonde spears are famed. Though not so large as those of the Masai, their spears and billhooks are cruel-looking weapons, with long barbs. The shafts are made of a dark, hard wood, and are frequently dyed black. They are ornamented, and often beautifully inlaid with a delicate tracery of brass, copper, or iron. They have fifteen varieties of spears, bearing different names.

The Storing of Acetylene.—In a recent letter to the Engineering News, Frederick H. Lewis gives the result of some instructive calculations. It has been claimed, it seems, by several concerns that acetylene gas may be liquefied and stored in metal "bottles," and in this form advantageously handled and transported. "The writer," says Mr. Lewis, "had occasion some time since to ascertain whether a small cylinder of about one half cubic foot capacity could possibly contain the amount of gas that the company's orator in Philadelphia had declared it to hold. A little calculation showed that if the gas was present, as stated, its density must be nearly equal to that of cast iron." Mr. Lewis calculates that a cylinder containing sufficient gas to supply a private house for a month would have to be about eight feet and a half long, and would weigh three hundred pounds. "But," he says, "even this statement of the case is entirely too favorable. The fact which the acetylene-gas people must face is this, that it is entirely unsafe to liquefy gas whose critical point is only 98° F., and subject such cylinders to the incidents of transportation and of ordinary use in dwelling houses. It has been found necessary to adopt this view in the case of nitrous oxide for dentists' use, and it will be necessary with acetylene."

Gout and Genius.—From an interesting little essay in the Lancet, by Mr. J. F. Thiselton Dyer, on the folklore of gout, we take the following: Many years ago one Misausus wrote a curious little book in honor of the gout, with the object of proving that it was a blessing for which mankind could not be too thankful, arguing that if Paracelsus could make men proof against death his secret consisted in inoculating them with gout. But when it was suggested that gouty people do die, he replied that men know not when they are well off, but must needs be curing the gout, and therefore deal with death's factor, the physician. It was, however, a popular notion that gout lengthened life, and statistics at the present day show that it is not answerable for more than one death in every seventeen hundred and eighty. For a long time gout had the reputation of being preeminently the rich man's disease, and Sydenham, who, it may be remembered, was the first man minutely to study the disease, remarked that, unlike any other complaint, "it kills more rich than poor; more wise than simple. Great kings, emperors, generals, admirals, and philosophers have died of gout." In one of Pitt's last letters to the Marquess Wellesley, he alludes to his slow recovery

from severe attacks of gout, and both the Earl of Chatham and Fox were afflicted by it. Horace Walpole was another victim, and, after comically describing himself as wrapped in flannels, like the picture of a Morocco ambassador, he says: "If either my father or mother had had it, I should not dislike it so much. I am herald enough to approve it if descended genealogically, but it is an absolute upstart in me, and, what is more provoking, I had trusted to my great abstinence for keeping me from it; but thus it is." Sydney Smith, when writing to the Countess of Carlisle in his seventy-first year, speaks of his gout, and humorously says: "What a very singular disease it is! It seems as if the stomach fell down into the feet. The smallest deviation from right diet is immediately punished by limping and lameness, and the innocent ankle and blameless instep are tortured for the vices of the nobler organs." The fact that gout occurs among the poor and temperate Faröe islanders, and that it may be generated by a low diet and abstinence carried to extremes, would seem to indicate that it is not always caused by overfeeding. Among some of the literary men and poets who have suffered from gout may be mentioned Fielding, Newton, Linnæus, Milton, Congreve, and Dryden, and of warriors included among its victims Lord Howe, Marshal Saxe, Wallenstein, and Condé. Dr. Cullen was strongly of opinion that all gout must be considered hereditary. Modern science has somewhat qualified this assertion, maintaining that three out of every five cases may be regarded as inherited. It is worthy of note that where there is a predisposition for gout a fit may be induced by the most opposite causes; and whereas Kingsley's "northeast wind" will excite it in some instances, a mathematical problem has been known to produce it in another. It seems incredible that any one should desire gout, and yet it is said that Archbishop Sheldon not only wished for it, but actually offered as much as five thousand dollars to any person who would keep him to it; for he looked upon gout as "the only remedy for the distress in his head." Gout is not confined to any one class, and has afflicted some of the ablest men in all ages, although, strange to say, it is five times more frequent in men than in women.

The Unapproachable Antarctic Continent.—Whether it will ever be possible to make a satisfactory exploration of the antarctic continent is a matter of doubt, on which very little if any light is shed by the reports of Mr. Borchgrevink, the latest navigator who has tried to penetrate the region. The defenses of the shores against approach are considerably more formidable than those of the arctic seas, and consist of the "pack," a moving mass of icebergs of enormous size, and floating ice; within this, a rim of compact ice, fringing the greater part of the shore, and extending out often several hundred miles from the land; and the ice barrier of the land itself. Captain Cook did not believe that any man would venture farther toward the pole than he had gone; but in 1823 a Captain Weddell found an unusually extended break in the ice fringe, and reached 74° 15′ S., but not the mainland. Yet he found the antarctic islands almost inaccessible, constantly covered with snow, except some perpendicular rocks, and nearly destitute of vegetation. Sir James Ross sailed in sight of the antarctic mountains, a hundred miles away, but was not able to make a landing. Wilkes saw land at several points, but could not pierce the ice barrier. Even if a landing were made, the country does not seem to afford even the poor facilities for exploration which the arctic regions furnish; it has few known animals and no inhabitants, of which arctic travelers are often able to make considerable use.

Metallic Iron in Water Purification.—Mr. F. A. Anderson recently delivered an interesting address before the Society of Arts on the purification of water by means of metallic iron. While this method is not a new one, and has been in use in various English towns for some years, Mr. Anderson's paper is worthy of attention as giving a very clear description of the apparatus and methods of the process. He says: "The idea of purifying water by agitating it with metallic iron is due to Sir Frederick Abel. The revolving purifier is a cylindrical vessel, supported horizontally upon hollow trunnions, through one of which the water to be purified enters; after traversing the cylinder it leaves by the other trunnion. The cylinder is caused to rotate about its axis by means

of a gearing. A number of curved shelves running longitudinally are fixed inside of the cylinder. The iron may be in any convenient form, but the most commonly employed in practice is the burrs or punchings from plates. The charge varies, of course, with the size of the cylinder, a purifier capable of treating a million gallons of water in twenty-four hours requiring about two tons. When the machine is set in motion, the curved shelves scoop up the charge of iron and shower it down through the water, thus causing a constant falling of iron across the current of the water. The effect upon the water of the agitation with iron is simply to cause a small quantity of iron, from one tenth to one fifth of a grain per gallon, to be dissolved. The water emerges from the purifier and passes to settling tanks, where the ferrous hydrate, which has been formed, is oxidized into ferric hydrate, and settles to the bottom of the tank. From the settling arrangement the water passes on to the filters, which are sand beds of ordinary construction; through these filters the water passes at the rate of from eighty to one hundred gallons per square foot per twenty-four hours, and emerges pure and free from any trace of iron. It was formerly considered that the iron had a more or less pronounced chemical action upon the dissolved organic impurities of the water; the oxide formed was considered to act as a carrier of oxygen, by means of which the organic matters were actually burned up and destroyed. It is tolerably certain now, however, that the real action is one of coagulation; the formation of a precipitate in the water tending to throw out of solution the dissolved organic substances, which form with the ferric hydrate insoluble compounds, so to speak, which are removed from the water by settlement and filtration. This view of the action of the iron upon the organic impurities of a water applies equally well to its action upon microbes. The germs are entangled in the gelatinous precipitate, and either subside with it to the bottom of the settling tank, or remain behind on the surface of the filter. Moreover, the film of oxide which covers the surface of the sand appears to act like a Chamberland-Pasteur filter, retaining the microbes while allowing the water to pass freely. A very important feature of the iron process consists in the rapidity with which perfect results are secured. A sand filter of ordinary construction will remove a very large proportion of the microbes in a water when its surface has become sufficiently blocked by the layer of matter, living and dead, separated from the water being filtered. To obtain this result, however, it is necessary to work the filter for days, delivering all the while imperfectly filtered water, until this layer has time to form. With the iron process, however, no such thing occurs. The practice is, when a filter is restarted after cleaning, to refill it from below with purified water from another filter until the surface of the sand is submerged; and then to admit from above water direct from the outlet of the purifiers, containing in suspension the whole of the iron oxide supplied to it. This turbid water as it settles immediately forms the desired film. Then the filter is set to work, and yields, from the first, water containing the minimum number of germs. The film thus formed is quite clean, and is never slimy or offensive.

Recent Experiments in Flying.—In an interesting article in Nature describing and picturing the flying appliances of Herr Otto Lilienthal, who has been experimenting for some time past near Berlin, it is said that his experiments "have from the very beginning been rewarded with a distinct success; and it seems that, given time, he may present us if not with a method of flying, then with an approximation to it, which perhaps at some later date may be more fully developed." He has already succeeded in making fairly long flights with perfect safety. His present apparatus consists of two parallel planes one above the other, the upper being about three fourths of a wing breadth above the lower. Each plane has an area of nine square metres. The planes are slightly concave on the lower side, and each one is divided into two wings by a fore-and-aft hinge. There are two rudders at right angles to each other fastened to the rear end of the lower plane. With this new apparatus Herr Lilienthal has already found that a step in the right direction has been made. The energetic movement of the center of gravity, and the consequent more safe management of the apparatus, had led him to practice in winds

blowing at times over ten metres per second. "These experiments," he says, "have given the most interesting results that I have arrived at since I began." With a wind velocity of six or seven metres per second, the sailing surface of eighteen square metres carried him against the wind in a nearly horizontal direction from the top of the hill without even having to run at the start, as is generally necessary. In a stronger wind he allows himself to be simply lifted by the wind from the hilltop and sail slowly against it. As experiments have shown, the sailing path is directed strongly upward by increasing wind force, and this fact causes him sometimes to be higher in the air than he was at his original starting point. In this position his apparatus has occasionally come to a standstill; and this leads him to make the following interesting statement: "At these times I feel very certain that if I leaned a little to one side, and so described a circle, and further partook of the motion of the lifting air around me, I should sustain my position. The wind itself tends to direct this motion. I have made up my mind by means of either a stronger wind or by flapping the wings to get higher up and farther away from the hill, so that, sailing round in circles, I can follow the strong uplifting currents and have sufficient air space under and about me to complete with safety a circle, and lastly to come up against the wind again to land."

MINOR PARAGRAPHS.

In a recent report to the French Academy of Medicine, M. Henri Monod says that from January, 1895, since the knowledge of antidiphtheritic serum and its uses has been extensively diffused throughout France, the statistics have shown a marked diminution in the mortality from the disease. In the population of one hundred and eight cities in France, each having more than twenty thousand inhabitants (the only places from which the reports are sent to the central administration), during the first six months of the seven years preceding 1895—that is, from 1888 to 1894—the average number of deaths was twenty-six hundred and twenty-seven. During the first six months of 1895 the diminution was 65·6 per cent. This diminution is not simply continuous, but is steadily increasing, as is proved by statistics from month to month. In a little pamphlet on this subject by Dr. Welch, of the Smithsonian Institution, he says that "the study so far of the results of the treatment of over seven thousand cases of diphtheria by antitoxine demonstrates beyond all reasonable doubt that antidiphtheritic serum is a specific curative agent for diphtheria, surpassing in its efficacy all other known methods of treatment for this disease," while "the essential harmlessness of the serum has been demonstrated by over a hundred thousand injections."

An accident of considerable scientific interest recently resulted in the photographing of a meteor. On November 23d last, at about ten minutes past twelve at night, Mr. C. P. Butler, of Knightsbridge, with the intention of focusing and testing the field of a new lens, placed a quarter-plate camera on the window sill, pointed it roughly at the region near the boundaries of Perseus, Andromeda, and Aries, and exposed it for about ten minutes. Upon developing the plate, the track of a meteor was the first impression to be perceived. Confirmation of the occurrence of the meteor is given by its having been observed from the South Kensington Observatory, both the time of the fall and the estimated region of its path being identical with the above observations.

M. Berthelot, says Industries and Iron, with the view of avoiding the inaccuracy arising from the unknown or irregular expansion of the containing vessel of the gas thermometer, has recently been experimenting with a new method of measuring temperatures. He employs the varying refractive power of gases at different densities. A given refraction always corresponds to a given density, though the pressure and temperature may be different. The principle is applied by the method of interference. A luminous beam is split up into two parts, which traverse two tubes filled with the same gas, and the initial appearance of the interference fringes is noted. One of the tubes is then raised to the temperature which it is

desired to measure, the pressure remaining constant and being that of the atmosphere. As the density of the gas diminishes, the interference fringes become displaced. By reducing the pressure of the gas in the second or cold tube, the fringes are brought back to their initial position; and this means that the density is then the same in both tubes. Now, the refraction of a gas is always exactly proportional to its density: the density of the gas in the cold tube is known from its pressure. Hence the density of the hot tube is also known, and from this its temperature is deduced. The method is thought to be well adapted for the measurement of high temperatures, such as those of furnaces.

NOTES.

Abundant testimony is cited by Mr. Walter Hough to the fact that the use of body armor was at one time general if not universal among the North American Indian tribes. The form was usually that of a sleeveless jacket, coat, or wide band, going around the trunk, suspended from the shoulders. At the period of its disuse, six types of armor were found on this continent and in contiguous regions—viz., rows of overlapping plates, perforated and lashed; wooden slats twined together; wooden rods twined together; bands of skin arranged in telescope fashion; coats of hardened hide; and cotton-padded armor.

Prof. Marshall Ward has found from his experimental work of the past few years that the appearance of colonies of the same bacterium, when grown under different conditions, are often very unlike. Distinctions of species, therefore, should not be based only upon the appearance of the colony, but should be drawn after study of all the conditions of the medium.

Dr. Treub, director of the botanical gardens of Buitenzorg, Java, gave an account, in the British Association, of the formation of hydrocyanic acid in the pangia tree (*Pangium edule*), and especially of the relation of the acid to the formation of nitrogenous material in plants. He considers that it is, in pangium at least, the first detectable nitrogenous material, and suggested, as an inference, that it is possibly very widely distributed in the vegetable kingdom as a transitory substance which becomes rapidly transformed into more complex substances.

The agitation of a proposition to rename one of the boulevards of Paris after Pasteur has developed the fact that besides there being already a rue Pasteur, twenty-one streets in Paris are named after chemists. Among the men thus remembered are Chevreul, Gay-Lussac, Lavoisier, Raspail, Davy, and Berzelius. Seven botanists are thus honored, one alchemist—Nicholas Flannel, of the fourteenth century—and twenty-nine doctors and surgeons.

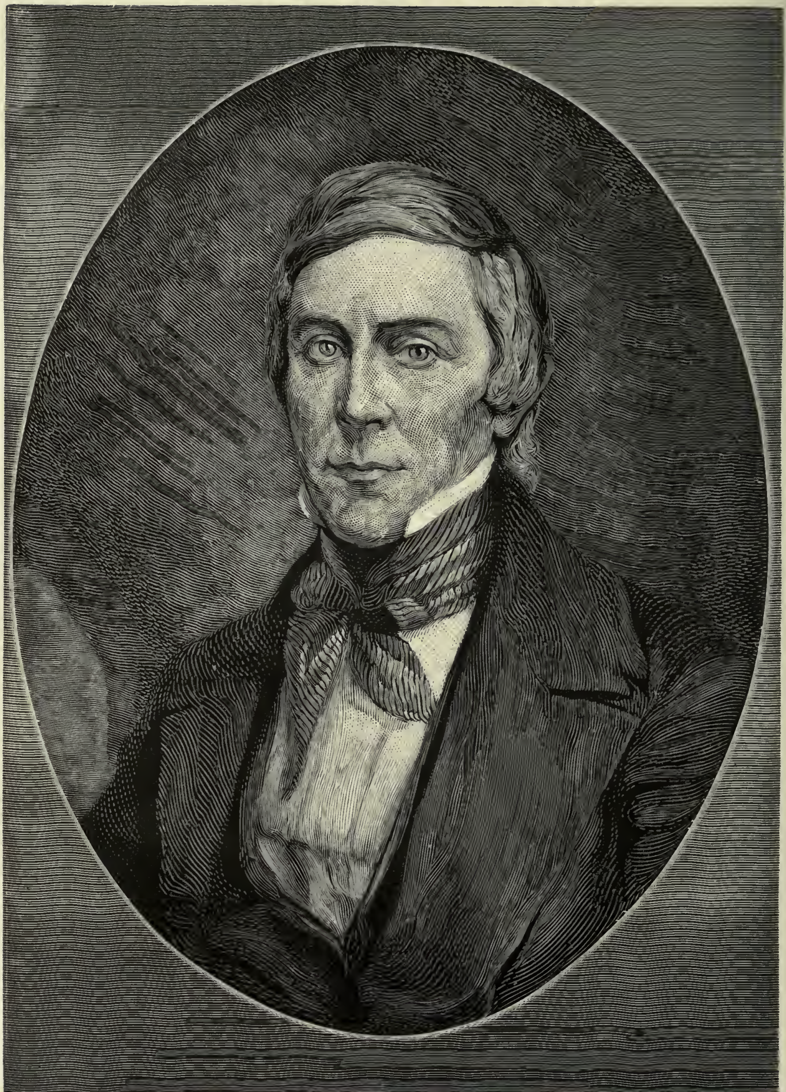
We gather from an article in Science that the *Conseil Supérieur de l'Instruction Publique* has issued a decree, removing the restrictions upon the admission of American and other foreign students to the French universities, and giving them a status substantially similar to that accorded by the German universities.

The gold medal of the Royal Astronomical Society has this year been awarded to Dr. S. C. Chandler, of Boston. Dr. Chandler's astronomical labors have been exceedingly numerous; but that which has attracted most attention is an investigation showing the probability that some small fluctuations of latitude, which had been noticed in particular places, were due to a motion of the earth's axis causing the poles to describe circles, thirty feet in radius, round a center, the period of this motion being about fourteen months.

A recent improvement in the simple pendulum for purposes of measurement is reported as having been made by G. Guglielmo. The simple pendulum oscillates about its point of suspension in all directions. The compound pendulum rests on a knife edge, or essentially on two points some distance apart, and therefore oscillates always in the same plane. A bob suspended by two threads will do the same. But for some purposes it is highly desirable to have a body oscillating in the same plane and parallel to itself. Sgr. Guglielmo has accomplished this by taking two such bifilar pendulums and joining them by a horizontal rod placed in their plane of vibration. A very useful application of it is an anemometer designed on this plan.

The average weekly earnings of laboring men in the United Kingdom are computed in the latest Blue Book to be 27*s.* 7*d.*, or £64 ($320) a year. But while this is the average, it is made up by balancing the wages of those who earn more and those who earn less; and it further appears that twenty-four per cent of the laboring men of the country have less than £1, or $5, per week.

Ludwig Rütimeyer, the distinguished naturalist, who died on the 26th of last November, was born at Biglen, in the Canton Bern, in 1825. His father was the parish clergyman, and the son intended to follow in his father's footsteps; but he was from his youth more interested in natural history than in theology. In 1848 he began the study of medicine, and for the rest of his life devoted himself to the study of comparative anatomy.



JAMES BLYTHE ROGERS.

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PRINCIPLES OF TAXATION.

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II.—THE PLACE OF TAXATION IN LITERATURE AND HISTORY.
PART V.

TAXATION IN EGYPT.—Herodotus, the Father of History, in writing more than two thousand years ago about Egypt, characterized it as a land of wonders, "containing more marvelous things than any other country," and in this opinion the judgment of succeeding ages, finding an all-sufficient warrant in primeval, stupendous, and mysterious monuments, has been compelled, as it were, fully to acquiesce. At this latter day, however, there has been added to Egyptian history what may be rightfully termed another wonder, namely, the most interesting and instructive experience in taxation in the world's history. Interesting and instructive because it affords the most striking and unprecedented illustrations of the results contingent on an arbitrary and unintelligent treatment of a heavy annual requirement of revenue for the support of a state, as contrasted with the results which have been the sequence of a wise and practical policy for a like purpose in the same country and under similar conditions.

Previous to the military occupation of Egypt by the British forces in 1882, consequent upon the suppression of the rebellion under the lead of Arabi Pasha, the condition of the country was wretched almost beyond conception. Its revenue system, in accordance with Asiatic ideas, comprehended nearly every form of iniquitous extortion. The principal source of revenue was essentially in the nature of a land tax; and for the dusky fellah, who represents the bulk of the Egyptian population, and who with a

grimy white shirt girded about his loins, plows, sows, and reaps to-day as his forefathers have done before him for thousands and thousands of years, this tax meant that his houses, his cattle, and his lands "were but so much food placed before the lips of our lord (the Khedive) that he might eat thereof and have his fill."

"The seed was often barely sown for the coming crop before the tax-gatherer appeared with the usurer as his familiar spirit at his heels, claiming not only heavy tithes of the treasury, but the many tithes of those tithes which never reached the treasury, waylaid on the road along the steep ascending gradients of a predatory hierarchy. For what purposes or to what amount he could be mulcted the fellah had no means of knowing. The only record he kept was the number of strokes from the *koorbash* which had wrung from him his last piastre. The only certainty he acquired by long and bitter experience was that, let his harvest be good or bad, only so much would be left to him as would barely suffice to keep body and soul together. Every year brought fresh imposts, and every new tax became in the hands of a corrupt administration a fresh pretext for unlawful exactions. To satisfy them the land was made to yield more frequent and more valuable but also more exhausting crops, until the soil itself caught the contagion of universal impoverishment. Still the arrears of taxation grew, and with them arrears of private indebtedness," until at last whole villages not infrequently petitioned the pasha "to accept the fee simple of their lands on condition merely that they should be allowed to rent them from him at an annual rental greater than the land tax itself, but still vastly less than the total amount of illegitimate imposts grafted on to the land tax."

Extortion for the purpose of obtaining revenue for the state, and plunder for the officials intrusted with its collection, was not the only form of oppression to which the miserable Egyptian peasantry were subjected. By an ancient Asiatic institution called the *corvée*, the fellah was liable at any moment to be seized and dragged perhaps off to some distant part of the country to work under constant dread of the taskmaster's whip at any task suggested by the caprice of the Khedive or some powerful pasha; and it was under this system of compulsory, unpaid, severe, unfed labor, and with great attendant sacrifice of the lives of his subjects, that the then Khedive, Ismail Pasha, mainly built the Suez Canal. In addition there was a system of "military conscription invested with the terrors of the press-gang; there was the water supply for irrigation, generally inadequate and often dependent upon the caprice of some local magistrate or corrupt official; there was the greed of unjust judges; there was the whole hungry bureaucracy, feeding upon those beneath it in order that it might in turn feed those above it."

Such, then, was the life that the fellah "lived in the days of the oppression"; not in the dim twilight of the past, but less than twenty years ago; not in remotely hidden corners of Egypt, but throughout its entire length and breadth.

In 1879 the exactions in Egypt, nominally for revenue, had become so oppressive, that the population refused to pay them, and, rising in revolt, drove Ismail Pasha from power and installed his son, Mohammed Tewfik, in his place. The new pasha found the finances of the country in such confusion, that he was obliged to invoke the aid of European Governments in order to obtain the means necessary to pay the interest on the public debt; and in this way the British and French Governments, as representing a large majority of the creditors, or holders of the debt, were practically given control of all the Egyptian sources of revenue. This condition of affairs was, however, in turn so repugnant to the people that in the spring of 1882 a revolt broke out, headed by Arabi Pasha, the then Minister of War, which, with a popular cry of "Egypt for Egyptians!" seemed for a time likely to be successful. But with the utter defeat of Arabi at the battle of Tel-el-Kebir, in September, 1882, the rebellion collapsed; Tewfik Pasha was restored to power, while the British forces, for the purpose mainly of maintaining the situation and insuring peace, practically retained possession of the country. It was under such circumstances that a reconstruction of the antiquated, arbitrary, and unequal Egyptian system of collecting revenue was entered upon as an immediate and imperative necessity for the establishment of a new and better national fiscal policy, and the attainment thereby of some degree of national prosperity.*

The career of Ismail Pasha, who as Khedive ruled over Egypt from 1863 to 1879, was a remarkable one. He was "as fine a type of the spendthrift as can well be found, whether in history or fiction. No equally reckless prodigal ever possessed equally unlimited control of equally vast resources. He came to the throne at a moment when there seemed to be no limit to the potential wealth of Egypt. The whole land was his to do what he liked with it. All the world was ready to lend money to develop it." The results of his government may be rightfully characterized from

* Notwithstanding the adverse criticism that has been made on the action and policy of Great Britain, under the then existing circumstances, subsequent experience has proved that it saved Egypt from barbarism and anarchy, and all the nations interested in that country "from incalculable losses in blood and treasure, to say nothing of the deep dishonor which these losses, foreseen and yet unhindered, would have brought on civilized mankind. The Arabist movement possessed great destructive force, but it had not within itself the elements necessary for the construction of anything enduring."—(*England in Egypt, Sir Alfred Milner.*)

almost every point of view as appalling. When he commenced to rule in 1863 "the debt of Egypt was a little over three million pounds sterling ($15,000,000). The annual revenue of the country was amply sufficient to meet all needful expenditure. Yet at the end of 1876 the debt had risen to £89,000,000 ($445,000,000). A country of six million inhabitants and only five million acres of cultivated land had added to its burdens at the rate of £7,000,000 ($35,000,000) a year. At the same time the taxation of land had been increased by something like fifty per cent. There is nothing in the fiscal history of any country, from the remotest ages to the present time, equal to this carnival of extravagance and oppression." (England in Egypt, by Sir Alfred Milner, late Under-Secretary for Finance in Egypt. London, 1894.)

The revenue annually collected under Ismail Pasha is probably not accurately known, and has been reported as high as £15,000,000 ($75,000,000) from an estimated population in 1872 of 5,203,000. But, whatever the amount, it is certain that a very considerable portion of what was wrung from the miserable peasantry, never found its way into any official ledger, or reached the national treasury. Of a great loan of £32,000,000 effected by the Khedive in 1873, only £20,700,000 reached the Egyptian treasury. The total amount sunk by the Government in the Suez Canal is estimated at £16,075,000 ($80,375,000). Yet Egypt has no share in the vast profits of the undertaking. It was not, however, the amount of taxation, crushing as it was in many cases, which worked the greatest mischief. "It was, above all, the cruel and arbitrary manner in which the taxes were collected. The fellah was seldom sure of the amount that would be demanded of him. He was never sure of the moment when the demand would be made. The moment might, as likely as not, be the very one in which he was least able to pay. Called upon to find ready money while his crops were still in the ground, he was simply driven into the arms of the money-lender. His choice lay between so many blows of the *koorbash* and the acceptance of the usurer's terms, however onerous. Under these circumstances money was borrowed at as much as sixty per cent per annum. Worse than that, it was often obtained by the sale of the growing crops, which were estimated for the purpose of the advance at half or less than half their value. This state of things was bad enough, and it was pretty general, but the ruin of the cultivator was consummated in many instances by positive collusion with the usurer on the hint of corrupt officials. The latter would demand the payment of taxes by the peasant, who was already in debt, at the very time when the interest on his debt was due. If he had any cash at all the authorities were bound to get it. When the usurer came after them, there was nothing left to the fellah but to surrender his land and

cattle, or renew his bond on still more ruinous terms. He was, in fact, entirely at the mercy of the lender."

That some betterment of such a condition of affairs was imperative if civilization was to be maintained and the substantial dissolution of Egyptian society prevented, seemed evident, and to effect it most rationally and speedily, an experiment was instituted that, as respects its nature and results, finds no parallel in the world's history. This in brief was the creation of a fiscal commission, by Sir Evelyn Baring, then British agent and consul general in Egypt (but now Lord Cromer, minister plenipotentiary), the members of which were selected solely by reason of their recognized qualifications for the work in hand and invested with almost autocratic powers. To this commission was intrusted the task of examining and reconstructing a revenue system of long duration and fortified by the precedents, customs, and prejudices, of an entire country, with a not inconsiderable population. The commission when organized in 1884–'85 entered upon its work under exceedingly unfavorable circumstances. The financial pressure was most acute. The magnitude of the national debt was apparently overwhelming; and the prices of the leading agricultural staples of the country, depressed in an extraordinary degree by world-wide competition, consequent upon improved conditions of production and transportation, seemed to preclude all possibility of obtaining any increased revenues from the masses by a continuance of the old, or even by any new methods of extortion. The first step taken was to abolish as rapidly and as far as possible all unnecessary and unproductive expenditures; and for this there was large opportunity. A diminution was made in the pension list, and in the number of superfluous and highly paid officials. By the concurrent action of the great powers of Europe the rate of interest on the funded debt of Egypt was also somewhat reduced.

The next important measure that claimed the attention of the commission was the grievance of the *corvée*, or system of enforced labor on the part of the peasantry on the public works; which, if entitled to be called taxation, was taxation of the worst and most wasteful kind, entailing sacrifices upon the people out of all proportion to the money which it saved to the state. It was not, however, found practical at the outset to abolish it altogether. The old practice by which the fellahs might be dragged away from their villages at any moment for any purpose, public or private, upon which the Khedive might choose to employ them, was at once totally abrogated. On the other hand, the agriculture of Egypt, the main source of support of her people, depends upon the water of the Nile, distributed through irrigating ditches or canals; and in order that these should fulfill their purpose, it is

necessary to keep them clear of the mud which the Nile at the period of its annual overflow brings down in large quantities; and to effect this, no other labor than that of the fellahs' is available. Finding that this indispensable work could be done by contract and paid labor, for about £400,000 ($2,000,000) per annum, the commission appropriated, from the funds made available from loans and the reduced expenses of the Government, the sum of £250,000, to be paid annually as compensation for such service, and thereby at once reduced by more than fifty per cent the number of men formerly called out and compelled to perform service; without payment. In addition, the employment of skilled engineers and the introduction of improved machinery for dredging and excavating, still further reduced both the necessity for the labor of individuals and the general aggregate of former expenditures. Whatever of the obligation of the *corvée* is still incumbent on the fellah, as, for example, when he is called in any sudden emergency to prevent breaks in embankments in time of flood, or keep clear the irrigation of his own land, is therefore largely in his own interest, and even this will probably at no distant day be abolished. But, be this as it may, it is certain that what of the *corvée* the commission has felt compelled to retain does not represent one tithe of the awful incubus which the old *corvée* represented "in the days of the oppression." The use of the *koorbash*, or lash, which was the former invariable accompaniment of unpaid labor in Egypt, has also been absolutely prohibited. Of other forms of relief to the people of Egypt, effected by the English fiscal commission, the following may be mentioned:

An abandonment of a tax on sheep, goats, and camels, which was very obnoxious to the agriculturists; a tax on weighing and measuring; *octroi* taxes on rice, oil, and other commodities; and a tax on all trades and crafts, in the nature of licenses on business and professions, which was collected in innumerable small sums from the poorest of the people. The price of salt, the supply and sale of which was a monopoly of the state, has been reduced to the extent of forty per cent, while large abatements have been made in judicial fees, postal and telegraph rates, and in railway rates and fares.

As formerly, the tax on land is yet the corner stone of Egyptian finance, and can not be rapidly or radically disturbed; but large measures of relief have nevertheless been instituted. A vexatious diversity of rates at which land has been assessed in different parts of the country has been simplified to the extent that a former total number of fourteen hundred different rates has been brought down to two hundred. The value of land varies greatly, according to its proximity to the Nile, and the extent to which it can be profitably supplied with water for irrigating pur-

poses—land devoted to growing rice crops requiring constant watering, but which must never be inundated. "From time immemorial Egyptian law has recognized an intimate connection between the land tax and water supply. The land which, in any given year, gets no water, is for that year legally exempt from all taxation whatever. As soon as it gets water its liability is established. But it is evident that the mere fact of receiving some water, though it may set up the liability of the cultivator to pay, does not insure his capacity to do so. In order to insure that, he must get his water in proper quantities, and at the proper times. But this is just what, in thousands of instances, he could not get, as long as the irrigation system remained in the state of unutterable neglect and confusion into which it had fallen in the period previous to the British occupation of the country." Arrears of land taxes throughout the whole country to the amount of about $5,000,000 have been remitted altogether by the commission, while lands incapable of cultivation, but heretofore made subject to taxation, have to a great extent been relieved.*

The area of land under cultivation in Egypt in 1894 was about five millions of acres; and in the least prosperous part of the country the tax on the same has been reduced, since the creation of the commission, to an extent of at least thirty per cent. The revenue from the taxation of land, which is at present estimated as not exceeding on an average £1 ($5) per acre, constitutes fully one half of the total receipts of the Egyptian treasury.

In 1886, before the reduction in this tax had been made,

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* "A considerable class of lands, called *mazroof*, sold many years ago by the Government at a quitrent which in the course of time had come to be looked upon as a specially high rate of land tax, has also been assimilated to the surrounding districts.

"Another measure of great importance for the future has been the adoption of more liberal fiscal regulations with regard to land brought for the first time under cultivation. Formerly the first attempt to reclaim a piece of uncultivated land brought down the taxgatherer, who at once subjected it to the full burden of the land tax. Now it remains untaxed until it yields the first remunerative crop, and then for two years it pays only half the normal rate. In the same broad spirit, facilities have been granted to people who are found without proper title in possession of land belonging to the Government, but on which they have spent labor and money in developing. Such occupiers can nowadays be confirmed in possession on very easy terms, in which full account is taken of all improvements. Finally, a scheme has been devised, and has been already applied with considerable success, for securing relief, without having to enter upon a general reassessment, in those no longer very numerous cases where the existing land tax is really excessive. Instead of allowing, as hitherto, arrears to accumulate which have ultimately to be remitted, the defaulting land is seized and put up for sale, but on such terms as to facilitate the re-entry of the owner on a lighter rating wherever the arrears are shown to be due to a prohibitive assessment in the past.

"Thus, not only the huge accumulation of arrears and the many smaller obstacles have been removed which blocked the approaches to the land tax, but the land tax itself has been cleared of its most mischievous excrescences."

its revenue product was £5,116,000 ($25,580,000—the Egyptian pound being about £1 0*s.* 6*d.*). In 1891 its product, after the large reductions noted, was £5,098,000 ($25,490,000); a result constituting a new and striking illustration of a little regarded principle of taxation, that low or moderate taxes are as a rule more prolific of revenue than comparatively high taxes. It is also worthy of note that the land taxes of Egypt under the reduced rates are collected with greater facility and much less expense than under the old system.

Viewed, as it should be, rather as a rent than as a tax, the present Egyptian tax on land can hardly be regarded as oppressive. The number of land proprietors in Egypt, according to the revenue returns for 1893, was 1,025,000. In only 8,569 cases were the fiscal officers obliged to seize crops in payment of the land tax. In three out of four of such cases the mere seizure acted as a sufficient threat to induce payment, and in only 2,158 cases was it necessary actually to sell the defaulters' crops. As for the seizure and forced sale of the land itself, there were only 1,865 cases of seizure and less than one in nine of actual sale—viz., 204. The number of expropriations for failure to pay the land tax had therefore been reduced to the infinitesimal proportion of one in five thousand.

The total revenue receipts of the Egyptian treasury during the year 1886, after the commission had begun to exert an influence on the fiscal affairs of the country, was £7,337,000. In 1890 they had increased to £8,040,000, and in 1891 to £8,366,000 ($41,-830,000). To the extent of about one third, this augmentation was due to heavier taxes on tobacco, and a few new taxes, as a tax on house occupancy, from which all foreigners previous to 1887 were exempt. In general, the increase in revenue receipts consequent upon new taxes imposed since 1885 has been about £570,000; but the reductions of taxation have at the same time been notably in excess of this amount. The public debt of Egypt, which was nearly £99,000,000 in 1880, has been increased in recent years to the extent of between two and three millions; but this increase has been mainly devoted to the redemption of pensions and to reproductive public works.

The general results that have been attained in Egypt under the fiscal and administrative policy of the British commission are, therefore, worthy at least of being characterized as extraordinary. They can not, moreover, be properly exemplified by any mere exhibit of figures. The benefit that has accrued to the Egyptian people can not be properly measured by a reduction of their taxes, but rather by the increase in their means of bearing the burden that remains. "The greatest vice of all in their old system of government was that, while the demands made upon

the people were constantly increasing, their capacity to meet those demands were being steadily impaired. The Government took from them twice as much as it was entitled to take, and did not give them in return what it was bound to give; while the coffers of the state and the pockets of its servants were being filled by the plunderer of the peasantry. The soil was deteriorating from the neglect of those great public works upon which its fertility depended."

All this abuse has now been entirely abrogated. For the first time since the days of the Roman administration, order and prosperity reign in the valley of the Nile.

At no previous period since Egypt began to have a name has the fellah lived under a government so careful to protect his rights. For the first time he is allowed to control the fruits of his labor. To-day, under British domination, every Egyptian peasant knows exactly the amount of taxes he has to pay, and when he has to pay them; and that when he has once paid the legal amount, no official, big or small, has the power to extort from him one single piaster beyond it.* He knows, too, that he can not at any moment be seized and dragged off as formerly, perhaps to some different part of the country, to work under constant dread of the whip, at any task suggested by the caprice of the Khedive or of some powerful pasha. Under such circumstances Egypt has never, certainly not within a recent period, enjoyed so large a measure of prosperity. Notwithstanding the recent universal decline in price of agricultural staples, the Egyptian products and exports of cotton, sugar, tobacco, wheat, etc., have rapidly increased, and at present are much greater than at any former period. The annual increase in the great staple product of Egyptian agriculture —cotton—from the average of 1884–'89 to that of 1893–'94 was nearly a hundred per cent, whereby the cultivator was not only able to pay his taxes more easily, but has more money left for his own needs.

When England first occupied the country the four-per-cent Egyptian debt securities were quoted at about 50, and not long before had been quoted as low as 27. To-day their quotation is over 100, with a reduction of their originally stipulated interest.

One of the most recent results of the British occupation of

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* "The poorest peasant in the country is now annually furnished with a tax-paper, *wird*, as it is called, which shows him exactly what he has to pay to the Government, and at what seasons the installments are due. The dates of these installments, moreover, which vary in different provinces, have been arranged so as to correspond as nearly as possible with the seasons when the cultivator realizes his produce, and is therefore in the best position to discharge his debt to the state. The necessity no longer exists of resorting to bribery as a protection against the extortion of sums not due on the part of the tax-gatherer."

Egypt has been a practical abolition of human slavery. Under existing regulations every slave in Egypt (the former great market for enslaved people of Africa) may demand his manumission if he chooses; and if the Soudan be retaken by Egyptian troops under British leadership, it will be equivalent to opening the prison doors to hundreds of thousands of captives.

In 1876 the district known as the "Fayoum," on the west side of the Nile, southwest of Cairo, was, according to a correspondent of the London Times, "reduced by misrule to the greatest depths of misery ever probably experienced in modern times in Egypt. The burden of taxation and oppression had produced an amount of want which almost bordered on starvation. At the present time (1894) it is one of the most prosperous and contented of provinces, and bids fair to become in the future the very garden of Egypt."

A further striking proof of the prosperity of Egypt under British administration is afforded by the financial report for 1895, made by Lord Cromer, the British diplomatic agent, which shows a revenue in excess of all expenditures for that year of £1,088,000 ($5,440,000).

That the continued prosperity and development of Egypt are dependent on the continued administration of the country by the British Government seems too clear to admit of questioning; and it is also not less evident that if Egypt should now be abandoned by it, all that has been done for it would be speedily undone.*

Finally, in considering the recent and remarkable fiscal experience of Egypt, one point of great economic interest should not be overlooked—namely, the lesson it teaches of the closeness of the relations of the finances of a state to the welfare of its people; and that these relations, which are apt to be obscured, or even wholly lost sight of, under conditions of high and complex civilization, speedily make themselves apparent, and are therefore more easily traced and studied in a country of limited area and simple conditions of living on the part of its people. This experience historically groups itself under three separate and distinct periods: *First*, the period of reckless prodigality under the reign of Ismail Pasha, from 1863 to 1879, of sixteen years. *Second*, a period of sudden retribution fraught with widespread misery, from 1879

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* In a recent debate (1896) in the British House of Commons, Mr. Chamberlain, the Secretary of State for the Colonial Department, said: "It would be impossible to pass judgment upon the policy of the Government unless the Government first made up its mind definitely in regard to the immediate evacuation of Egypt. Nothing in recent history could be looked back to with more pride and satisfaction than the peaceful revolution in Egyptian affairs which had been accomplished with a handful of men and a British civil administration. If Egypt should be abandoned, all this would be undone. Egypt must be defended if her prosperity was to continue."

to 1886. *Third*, a period of recovery from utter collapse, from 1886 to the present time, the result of intelligent fiscal administration so signal and complete as to be without precedent in history. It remains to be seen what will happen in the future in the event of the withdrawal of British occupation and governmental administration of the country in compliance with the wishes of all the other great powers of Europe.

An illustration of how history in Egypt has seemingly repeated itself in respect to taxation is here pertinent to the subject. Prior to the nineteenth century a key to the hieroglyphic writing of Egypt or of the so-called "demotic," which was a shorthand or abridged form of the true hieroglyphics, had not been discovered, and there was little probability that it ever would be.

In 1799, however, during the French occupation of Egypt, a large slab of black granite (now in the British Museum), which originally had been a monument in some public edifice, was discovered in excavating for military purposes near the village of Rosetta, a place in Lower Egypt not far distant from Alexandria and the western mouth of the Nile. The slab had on it three inscriptions—the first in hieroglyphic text, the second in the demotic character, and the third in Greek letters; and a study and comparison of them, mainly by Champollion, a French scholar, led to a solution of the problem of deciphering the hieroglyphic writing, which previously had almost completely baffled analysis. It was then found that the trilingual inscriptions were in the main a copy of a decree in honor of Ptolemy V, Epiphines, King of Egypt, who, about 193 B. C., had conferred great benefit on his country and its people by remitting certain taxes and reducing others, and read as follows:

> Considering that the King Ptolemy, ever living, the well-beloved of Phtah, most gracious son of the King Ptolemy and of the Queen Arsinoë—gods philopatores (father-loving)—has done all kinds of good; . . . that he has not neglected any of the means within his power to perform acts of humanity; that in order that in his kingdom the people and in general all the citizens should be in prosperity, he has suppressed altogether some of the taxes and imposts established in Egypt, and has diminished the onus of others: . . , It has therefore pleased the priests of all the temples of the land to decree that all the honors belonging to the king shall be considerably augmented; that his statue shall be erected in the most conspicuous spot in each temple; that the priests shall perform three times each day religious service to these statues; and that in all great solemnities all the honors due to other deities shall be paid them. . . .

More than two thousand years have elapsed since the service rendered by Ptolemy to Egypt and its people by the remission and readjustment of taxes was thus commemorated. King,

priests, and people have long since passed away; but if they could return, their gratitude to the English tax commission for the service rendered to their country and to their descendants would certainly again be recognized and fitly commemorated.

Another point of historical and fiscal interest in connection with Egypt is worthy of notice. Of the conquest and occupation of Egypt by the French, 1798–1801, the masses of its people have but little knowledge; but the name of General Kléber, to whom the government of the country was intrusted by Napoleon on his return to France, is still held in grateful remembrance, coupled with the highest title that the Arabs could bestow upon him—namely, "The Just"—because under his rule, as popular expression has it, "he levied taxes only once." *

Taxation in Brazil.—A most striking and instructive example of the strangulation of the commerce of a country, and its consequent impoverishment by reason of a vicious system for the collection of revenues, is to be found in the recent experience of the South American state of Brazil. Its Government derives its support mainly from export and import duties, and every province, whether maritime or interior, collects a separate duty of generally about four or five per cent on its exports, to which in some instances a municipal tax is added. There is no taxation upon either real or personal property; but when a piece of real estate is sold, the purchaser is required to pay a fee to the Government of five per cent on the selling price. All stores are obliged to obtain a license, for which a fee is exacted, the amount varying with the kind of trade. The duties on imports are extremely heavy, and on many articles, especially foods, are in excess of their original cost at their place of production. On some of the principal articles of export the duties have been as high as twenty-three per cent *ad valorem*, on rubber and cocoa fourteen per cent, and thirteen per cent on coffee. Few countries have greater commercial and industrial possibilities than Brazil; but Nature's prodigal efforts have been rendered futile by a vicious system of taxation, which has so restricted the development of her resources that the increase of exports in recent years has been mainly confined to the single article of India rubber, for the supply of which the country has practically a monopoly. What is raised in Brazil is taxed;

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* For the material which has furnished the basis for the foregoing narrative of the recent fiscal (tax) experience of Egypt, the writer has been mainly indebted to a book, England in Egypt, London, 1894, by Sir Alfred Milner, formerly a member of the Egyptian Fiscal Commission, and now chairman of the British Board of Inland Revenue; to a series of letters published in the London Times in 1894; to various official documents, and interviews with those personally conversant with the subject under consideration.

what is bought by her is taxed; while taxes are levied on her product of labor and on the payments for such products. The general result, therefore, has been that the world can buy comparatively little of the Brazilian, and the Brazilian has comparatively little with which to buy of the world.

HOW THE GREAT LAKES WERE BUILT.

By J. W. SPENCER, Ph. D., F. G. S.

THE framing of the continent was a work of great antiquity Upon that foundation the plains and mountains were slowly built, and out of them the valleys have since been carved. The last touch in the completion of the continent has been the making of the lakes. The work is geologically new, and the knowledge of how the lakes were produced is only a few years old—or about a decade and a half since the students have been seriously attempting to disentangle the complex history of the lakes, and from the maze of disorderly speculation to bring together an orderly assemblage of scattered facts and events. To have partially accomplished this effort, it required tedious waiting for the discovery of connecting links which were not always obtained in their logical order; and it was often necessary to learn how to look for them, and so the footsteps had to be retraced many times before the lost trails were recovered. Many new things have been learned in studying the history of the lakes, but the most striking physical changes have been during the period immediately preceding and reaching into modern times.

High Continental Altitude of Former Times.—In very ancient times the lake district formed a great plateau at a considerable altitude above the sea, with some bordering mountains or high lands. Those ancient plains have since been molded into rolling hills and broad valleys, and the mountains have been worn down to almost plains themselves. When mountain ridges are close upon the sea or adjacent low plains, at so slight an elevation that the streams are all sluggish, then, aided by chemical action, the rains and streams are always washing down the elevated lands, first making ravines and valleys, and then enlarging them into broad plains with low hills, for the level has been reached below which the agents of destruction can scarcely affect the slightly elevated lands, as is illustrated in Figs. 1 and 2.

If the plains were always to remain at low altitudes, increasing slightly in elevation in proceeding landward, above the drainage basins, and with the high lands gone or going, the country would become monotonous without any bold reliefs or the possi-

bility of the formation of any deep valleys. While such finished conditions may often occur over large districts, yet such is not the character of very great regions, as Nature seldom allows the completion of these processes, for with the wearing down of one area another quarter is elevated by internal forces, until new plateaus rise in bold relief. The rains gather into streams and cut out gorges and valleys with their forms depending upon the character of the rocks and the length of time that the erosion is in progress. The gorges and valleys grow in length, like the Niagara cañon, until the slopes of the streams become so gentle that they can not deepen their channels any more. After that stage, the only work of the river is to carry away the rocks dissolved or washed from the sides of the valleys, which are thus widened into broad flats, and in their later stages great plains. Such a formation of base planes of erosion is illustrated in Fig. 2.

Fig. 1.—Section showing a Hillside (*d c*) being washed down to the Base Plane of Erosion (*c b*), which is itself almost reduced to Sea Level.

Applying this process of denudation to the lake region, it becomes evident that the land must have stood high enough above the sea for the rivers to remove the *débris* washed into them by the millions of little streams—that is to say, the continent was sufficiently high for the excavation of the deepest valleys now beneath the lake waters. As the sea was very distant from the lakes, much farther than now, and the upper lake basins were still farther inland, the altitude of the continent must have been even greater than the depth of the deepest lake basin below the sea level. On the other hand, the slope of the land must have been gentle, with the elevation just high enough to allow the drainage of the valleys, without the production of cañons through them, and to enable the streams to widen them into broad, rolling hills and plains scores or hundreds of miles wide. (See Figs. 13 and 14.) The necessary altitude may have varied from time to time, but the duration of the proper conditions was very long. The elevation was not merely high enough to allow the reduction of

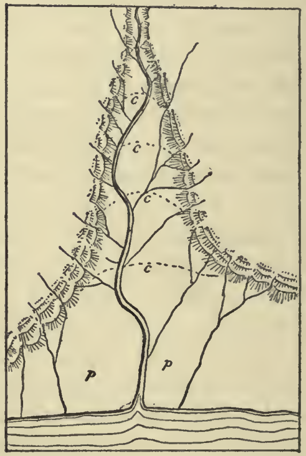

Fig. 2.—Map of a Plateau being transformed into a Valley (*c c c*), which is broadening out into a Plain (*p p*). The sluggish river is only acting as a carrier for the removal of the land washes.

the table lands to a depth of five hundred feet below sea level, as is shown in the Ontario basin at this day, and the upper lakes to nearly as great a depth (Lake Erie alone being shallow, but with deep buried channels running through it), but high enough to allow for the necessary slope down the St. Lawrence Valley, not merely to the present gulf, but to the edge of the continent, some eight hundred miles from the present outlet of Lake Ontario. In short, the lake region was elevated more than twelve hundred feet higher than now, which amount itself is indicated by the soundings of the Gulf of St. Lawrence.

While the lake district was thus moderately elevated for long ages, there was an extraordinary altitude of the continent lasting for a comparatively short time, as is seen in the drowned valleys near the coastal margin of the continent; but this elevation did not last long enough for the great cañons to be cut back to Lake Ontario.

The lake basins are simply fragments of the old valleys of the St. Lawrence River and its tributaries. These normal but ancient depressions have since been obstructed so as not to allow a free drainage and are thus turned into lake basins with the district further depressed, partially below sea level. The manner in which these things were accomplished is now our theme.

Drowned and Buried Valleys.—Fragments of the ancient valleys which existed in the lake region are discovered by the

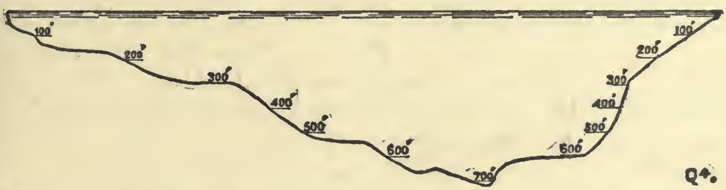

Fig. 3.—Section across Lake Ontario from Point Peter to Pultneyville, showing the submerged valley with the bounding escarpment.

soundings in the lakes. Throughout or across some of them great, broad channels, resembling old land valleys, such as are seen in every country, extend, and are bounded on one side or another by the steep slopes of some drowned mountain or escarpment, three hundred or four hundred feet high. Such a valley occurs in the Ontario basin, of which Fig. 3 is a cross-section. An equally good example may be seen in Lake Huron and other lakes. But at the surface these drowned valleys do not appear connected. What do they mean? We shall see.

In the lake district wells have been sunk for considerable depths for water, oil, and gas. On the now level plains the borings have often penetrated great depths of loose rock and dirt

deposits before reaching the solid strata, yet, perhaps in proximity, the bedded rocks appear near the surface of the country. These depressions are portions of ancient valleys which have been filled often to depths of five hundred feet, and in some cases probably to a thousand feet. By chains of borings the buried valleys may be traced. Their general course is frequently shown by the surface features; but without the borings their great depth would not be suspected. Thus the Dundas Valley may be taken as an example. It is situated at the head of Lake Ontario and bounded by mountain walls, but is also deeply buried by drift, as shown in Fig. 4. Some of the filled valleys are chiefly occupied with bowlder clay; in other cases with both till and stratified materials; so that their burial is not always alike. Not merely have many of the old valleys been filled with the sweepings of the highlands, but they have been further obscured by the submergence of the district beneath the modern lake waters.

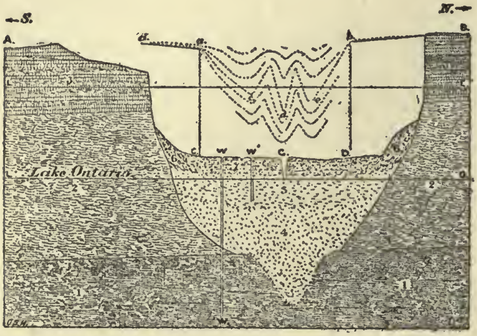

Fig. 4.—1, Hudson River formation; 2, Medina shales; 3, Niagara and Clinton dolomites with some shales; A, C, D, B, modern valley at meridian of Burlington Heights; *a*, C, D, *b*, modern valley at meridian of Dundas; *a*, *c*, *d*, *e*, *b*, sections across, deeply excavated in beds of streams in western part of the Dundas Valley; 4, bowlder clay filling ancient valley; 5, Erie clay; 6, talus from sides of escarpment; 7, old beach, one hundred and sixteen feet above lake at Burlington Heights; G, Desjardin's Canal leading from Dundas marsh to Burlington Bay; W, W, well at Royal Hotel, Hamilton; W′, another well at Dundas; L, O, level of Lake Ontario; L, E, level of Lake Erie. Valley at Dundas two miles and a half wide and depth five hundred feet.

The Course of the Ancient St. Lawrence compared with that of the Modern River.—In seeking for the explanation of the drowned and buried valleys, discoveries have been made showing that some of them can be connected, and thus is the change in the course of the ancient Laurentian (so named to distinguish the old water way from the modern) River established. The modern St. Lawrence River is characterized by the most remarkable system of lakes in the world. The basins are very deep, and not mere expansions of a river having no noteworthy depth. In the soundings of the lakes and in the buried valleys the connecting links of a great chain of evidence are welded together, showing that the ancient water way did not pursue the present eccentric course, but was an ordinary river valley of large size, yet its course was not everywhere coincident with that of the modern stream.

From the northern portion of the Michigan basin the channel of the ancient Laurentian River is more or less buried beneath

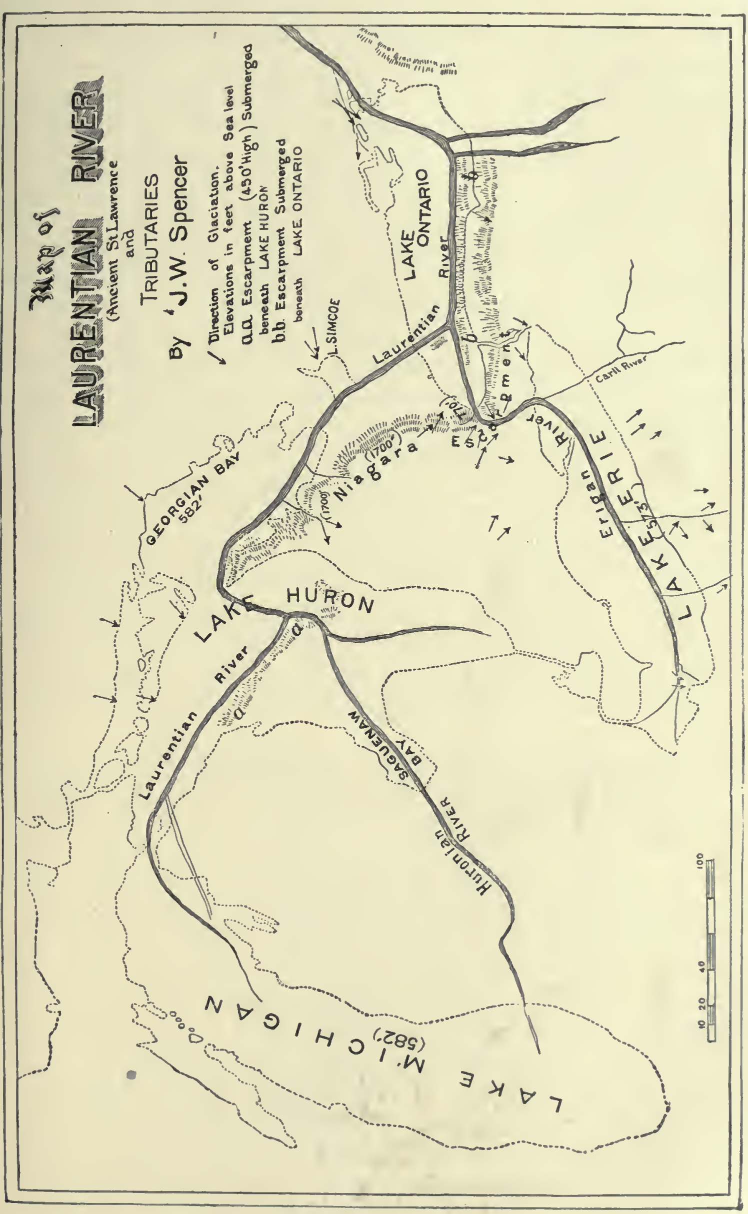

Fig. 5.—Map showing Course of the Ancient St. Lawrence and its Tributaries.

drift and also submerged in extending by way of Mackinac Straits to the Huron basin, across which its course is plainly marked at the foot of an escarpment from three hundred and fifty

to four hundred and fifty feet high, and the whole somewhat further submerged. Again it passes through the narrows across the broken mountain ridge into Georgian Bay, where the deep channel skirts the foot of another high escarpment. The old water way across these lakes is shown on map (Fig. 5).

From Georgian Bay the ancient channel is buried below drift deposits to a known depth of seven hundred feet, and almost certainly the drift reaches to a depth of one thousand feet beneath the highest obstructing ridges. The course of the channel passes through Lake Simcoe and enters the Ontario Valley about twenty miles east of Toronto, where the deep trench is made known by the soundings in the lake. The buried valley was broad and comparable to the portions through the lakes. On its western side, but some miles away, it is paralleled by the "mountain" or Niagara escarpment, which reaches to more than fifteen hundred feet above the sea. On the eastern side of the valley the plains are underlaid by solid rock, although these are often covered by drift ridges. Between these rocky boundaries the drift has been penetrated to great depths in many places, yet in the center of the channel the bottom of the filling has never been reached.

Throughout the Ontario Valley the Laurentian River flowed at the foot of a high escarpment now submerged (see Figs. 3, 5, 11). At the eastern end of Lake Ontario the channel turned toward the present outlet of the lake and then down what is now the modern course of the St. Lawrence to the sea. The origin of the barrier across the present outlet of Lake Ontario will be noticed later.

One of the great tributaries was the Huronian River, crossing the southern portion of Michigan, as shown upon the map (Fig. 5), and extending through Saginaw Bay to join the Laurentian River farther north. The Superior outlet is supposed to have crossed the upper peninsula of Michigan and joined the branch draining from the northern end of what is now Lake Michigan.

The now shallow Erie basin was then a portion of a plain across which the ancient Erigan River flowed in a valley two hundred feet or more in depth. One of the buried and submerged tributaries at Cleveland was described by Dr. J. S. Newberry, others by Dr. T. Sterry Hunt, and those near Buffalo by Dr. J. Pohlman. From the Erie basin the Erigan River crossed by a channel about forty miles west of the Niagara River, which did not then exist, and passed down the Dundas Valley (Fig. 4) into the head of the Ontario basin, and farther eastward joined the Laurentian River (Fig. 5). All the features of the ancient and drowned valleys are those characterizing ancient topography; that is to say, without the boldnesses and abruptnesses of youthful features and without great waterfalls, although rapids must have existed.

Reversals of Ancient Rivers in Pennsylvania and New York.—The great changes in the water way of the Laurentian River had their counterpart in the highlands to the south of the lakes where the ancient streams were tributary to the Laurentian, in place of to the modern Ohio and Susquehanna Rivers. Among the more notable changes, the Alleghany (discovered by Mr. J. F. Carll) flowed to the Erie basin, as did also the upper Ohio (suggested by the writer, and further explained by Dr. P. Max Foshay and Mr. F. Leverett). These and other streams now reversed were tributaries of the Erigan River. In New York the upper Susquehanna and some tributaries descended through the "finger lakes" to the Laurentian River as it passed through the Ontario basin. All the old streams coming from the highlands south of the lake basins flowed through broad, V-shaped valleys, of ancient form, although of considerable depth. These valleys became filled with drift which turned the waters of the Ohio and Susquehanna Rivers to the south. This reversal in the drainage has been further assisted by the recent northward tilting of the land, to be explained later.

How the Ancient Valleys were Obstructed.—The Laurentian Valley and its tributaries were completed before the ice age. Indeed, the high elevation of the continent during the culmination of that period did not last long enough for the deepening of the channels of the main valley, as they could scarcely be affected until a great cañon had been excavated from the continental margin for eight hundred miles to the Ontario basin, which was not the case.

As for the modification of the ancient topography by glacial action, it could have been only slight, and does not appear to have been more than the sweeping of loose geological dust into the valleys, or on to the highlands to the south. The absence of any great plow is shown by the direction of the scratches on the rock surfaces, which lines are everywhere at great angles to the walls and sides of the lake basins, and nowhere parallel to them, as must have been the case if the valleys had been plowed out by ice in any form. This crucial test and many other features had not been applied fifteen years ago, when the writer commenced these researches. Now this fancy of closet geologists has vanished before the application of facts. Yet the work of the ice age was complex, and it is immaterial to the study of the lakes how it was performed. In one way only does it come within the limit of this subject, and that is in the phenomena of the ancient valleys being filled by drift, whether stratified or not. It was this filling of the old channels with drift that closed the ancient drainage of the Laurentian Valley, which at a later date gave rise to the lake basins. But the barriers of the lakes were further exagger-

ated by the tilting of the land, which will be noted later. The closing of the old water ways ends the history of the ancient Laurentian River. When the river began to flow again, the lacustrine epoch was established.

SUBMERGENCE AND RE-ELEVATION OF THE LAKE DISTRICT.—After the obstruction of the valleys with drift, the whole lake region was submerged; but this depression is best treated of in the rising of the land which has brought the evidence to view.

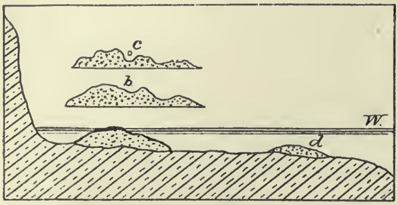

FIG. 6.—SECTION SHOWING THE FLOOR OF A CUT TERRACE ON WHICH RESTS A BEACH. *b* and *c*, beaches broken into ridgelets; *d*, a frontal sand bar; W, old water level.

As the waves beat upon the shores, the beaches, terraces, sea cliffs, sea caves, etc., become characteristic of coast lines. When the water sinks or the land rises, the various stages of the deserted shore remain and record the recession of the waves. The preservation of the old coast lines is often so perfect as to furnish easy identification of their character, as may be seen in Figs. 6 and 7, which represent sections of old beaches. Behind them lagoons often occur, and the entrances of bays are often barred across with beaches, as is shown in Fig. 8.

The resemblance between modern and ancient shores is further illustrated in Figs. 9 and 10, where great bowlder pavements are shown, marking the modern and deserted strands. In valleys, although broad, beaches do not occur, but they are replaced by terraces.

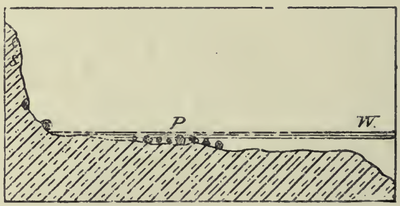

FIG. 7.—SECTION SHOWING THE FLOOR OF A CUT TERRACE WITHOUT BEACH, BUT WITH BOWLDER PAVEMENT. P, bowlder pavement; W, old water level.

The deserted beaches and terraces in the lake region occur at all altitudes, where such could be preserved. But in order to find the remains of old shore lines continuous over long distances, it is necessary to descend to the levels where the water was more or less confined in the western and central portions of the lake district, for until a recent date there were no barriers toward the northeast sufficiently high to hold the waters of the lakes above tide. In the prenatal lake epoch, such an embayment called for in the last sentence covered two hundred thousand square miles of the lake region, and has been named Warren Gulf. As there was no land barrier to this gulf in the northeastern direction, and for the

exclusion of the sea, of which there is no evidence, some have supposed that these waters of the lake district were held at high altitudes by glacial dams for long ages. This hypothesis, notably advocated by Prof. G. K. Gilbert, although based upon negative evidence to explain some difficulties, which are also applicable to southern regions even within the tropics, has retarded the researches into the history of the lakes, and had it been followed would have prevented the discovery of some of the greatest changes in the geography of northeastern America. Indeed, the greater portion of the modern elevation of the region has been

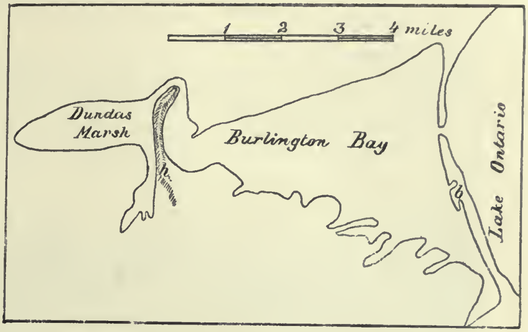

FIG. 8.—MAP OF THE WESTERN END OF LAKE ONTARIO. *b*, Burlington Beach, separating Burlington Bay from the lake; *h*, Burlington Heights, an ancient beach one hundred and eight to one hundred and sixteen feet high, separating Dundas marsh from Burlington Bay.

FIG. 9.—MODERN BOWLDER PAVEMENT ON GEORGIAN BAY, east of the end of Blue Mountains of Collingwood, Ontario.

recorded in the tilting of the beach lines recognized by all. But the period of glacial conditions was prior to the lacustrine,

which commenced with the submergence of the lake district to sea level.

THE TILTING OF THE ANCIENT SHORE LINES.—The shore lines of ponds, lakes, or seas are alike water levels. In this respect the

FIG. 10.—ANCIENT BOWLDER PAVEMENT OF ALGONQUIN BEACH, whose crest rises one hundred and eighty-seven feet above Georgian Bay, upon the northeast side of Blue Mountains of Collingwood, Ontario.

elevated coast lines present a striking difference from those now being formed, for the abandoned strands are everywhere tilted toward the northeast (see Figs. 11, 12, 15).

The tilted beach represents the deformation of the Algonquin beach. At the head of Lake Erie the deformation of the old water planes is not over a very few inches in a mile, while it

FIG. 11.—SECTION OF THE LAKE DISTRICT FROM THE HIGHLANDS OF NEW YORK TO THOSE OF THE LAURENTIAN HILLS NORTH OF LAKE HURON, ALONG A LINE PASSING THROUGH BUFFALO AND LAKE NIPISSING. Length of section, four hundred miles; heights given in feet; *t* is a ridge of drift north of Lake Ontario. The tilted beach represents the Algonquin plain deformed.

increases toward the northeast, so that it amounts to four feet per mile northeast of Lake Huron, and seven feet per mile near the outlet of Lake Ontario and north of the Adirondack Mountains, to which locality the writer himself has traced the deserted shores

all the way from the head of Lake Michigan. This gentle deformation of the surface of the country when carried over such long distances gives rise to the great physical reliefs of the mountain regions of the north and east, which were much lower before the lake epoch than now, as is apparent if the tilting be straightened out, as may be seen in the sections given. Furthermore, the character of the river courses at the surface of the country north of the lake regions indicates that even in the ice age the relatively high reliefs north of the lakes did not obtain.

THE GULF EPOCH.—In the re-elevation of the lake district after the post-glacial submergence, when the continent was high enough to partially inclose a large gulf, already referred to, to which the name of Warren Water has been given, or more correctly Gulf, there were several water connections through the valleys to the south and west of it. Its last stage as one body of water is marked by the Forest beach, as shown on the map (Fig. 13). Upon the further rise of the land the surface of Warren Gulf fell below the level of the Forest beach for a depth of a hundred and fifty feet. The movement was gradual, without striking

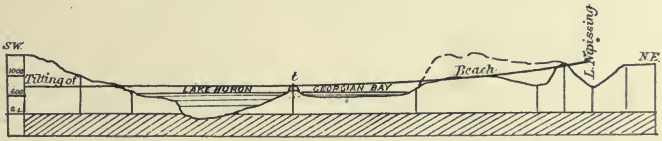

FIG. 12.—SECTION FROM THE MICHIGAN HIGHLANDS BACK OF ALPINA TO THE LAURENTIAN HIGHLANDS BEYOND LAKE NIPISSING. Length of section, three hundred and thirty miles. The tilted beach represents the deformation of the Algonquin beach.

interruptions, for there is no intervening strand, as the water did not remain at one level long enough to leave beaches. Warren water was now broken up into two great gulfs; the one called the Algonquin, occupying the basins of Lakes Superior, Michigan, and Huron, and opening to the northeast, through the strait to the Ottawa Valley, as is shown on the map (Fig. 13); the other was the Lundy Gulf, occupying most of Erie basin, and extending over the Ontario Valley at a great height. In the region of Nipissing Strait the two gulfs united.

From the deserted shores of these waters, which are now tilted up so much to the northeast, free communication between the lake region and Hudson Bay is indicated, for the Laurentian highlands are now rarely more than fifteen hundred feet above the sea and commonly less. Of course, there was free communication to the Atlantic Ocean by way of the St. Lawrence and also southward of the Adirondacks. These various characteristics and changing conditions would require a volume to tell all that we know about them, and this has been partly done in Duration of

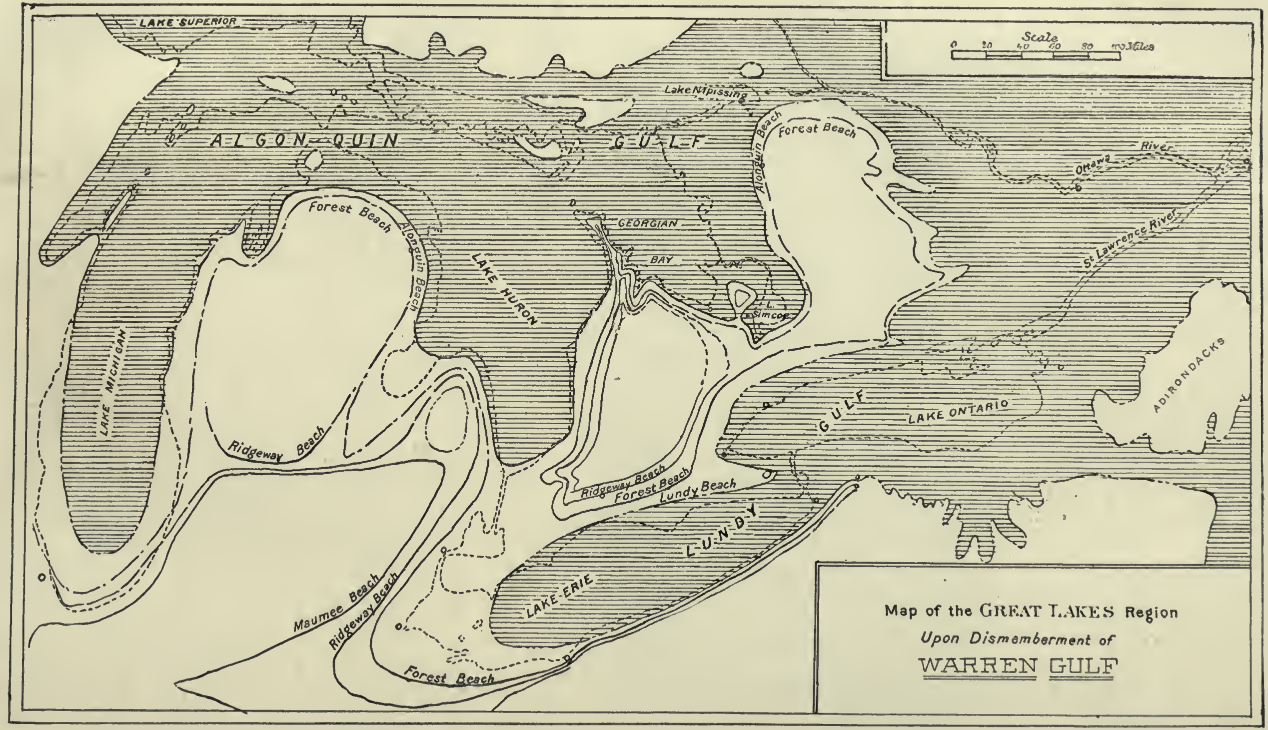

Fig. 13.—Map of Warren Water, bounded by Forest Beach, and its Successors. Surveyed shores represented by solid lines; partly surveyed, by broken lines; modern lakes, by dotted lines.

Niagara Falls and the History of the Great Lakes, by the writer, and published by the Commissioners of Niagara Falls Reservation, under the presidency of Hon. Andrew H. Green.*

THE BIRTH OF THE GREAT LAKES.—This marks only an episode in the chain of events which are being described, when the waters fell three hundred feet below the Algonquin and Lundy planes. Although the subsidence of the waters was not continuous and left some evidences of temporary pauses, yet the long rest was not reached until they had sunk to the level of the Iroquois beach. By this time the land had risen so high, and, as there were no sufficient barriers, the upper lakes sunk far within their present basins, as is shown on the map (Fig. 14). Still, the waters of these upper lakes discharged by way of the narrow Nipissing Strait.

Lake Erie at this time had its birth, but then it was a very small body of water, as shown on the map. The Niagara district was then covered with a strait expanded into a lakelet, and afterward a river at first without a fall. In the further sinking of the water to the Iroquois level the falls of Niagara commenced their history, and then there was a comparatively long rest, but Ontario was still a gulf, as shown on the map (Fig. 14).

The plane of the Iroquois shore was at identically or nearly the same level as the Nipissing beach (of Taylor) at the outlet of Lake Huron by way of the Ottawa Valley. It is not apparent, and it is theoretically improbable, that the Nipissing River was characterized by more than a gentle slope, for by the time that the land rose high enough to produce a rapid river the water of the upper lakes had changed their outlet into Lake Erie. The proof of these changes rests in the tilting of the beaches, which aggregates several hundred feet (see Fig. 12).

BARRIER TO LAKE ONTARIO.—Still, the land has continued to rise, and the deformation since the Iroquois episode amounts to more than before that date. The tilting at the head of Lake Ontario becomes an absolute elevation above the sea, amounting to three hundred and sixty-three feet, and at the northeastern corner of the Adirondacks it is fifteen hundred feet, while near the outlet of Lake Ontario it is seven hundred and thirty feet. This warping of the continent is illustrated in Fig. 15, and to it is due the barrier (to a large extent) which retains the waters of the Ontario basin at an elevation of two hundred and forty-seven feet above the sea.

SINKING AND SUBSEQUENT GROWTH OF THE MODERN LAKES AND CHANGE OF OUTLETS.—The continuing elevation of the con-

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* The surveys of the deserted shore lines of the lakes have been mostly made by Messrs J. W. Spencer, G. K. Gilbert, A. C. Lawson, and F. B. Taylor.

tinent lowered all the waters of the lake region until their levels depended upon the rims of the lake basins from which the waters overflowed. The upper lakes were the first to sink far within

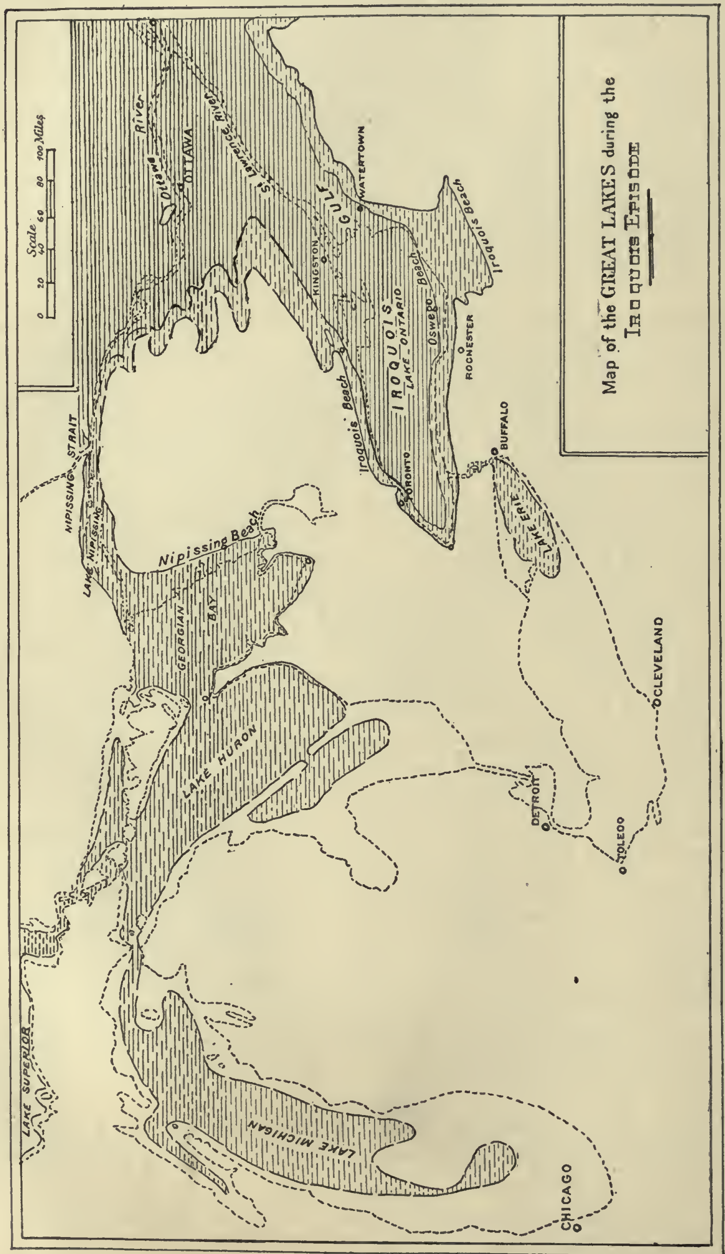

Fig. 14.—Map of the Early Lakes. Broken shading represents extension of the early lake epoch; solid shading, a lower stage of Iroquois Gulf before the birth of Lake Ontario; modern lakes, by dotted lines.

their basins (see Fig. 14), but later even the Iroquois Gulf was contracted so as not to occupy even the head of the present Ontario basin (see Fig. 14).

The great deformation of the whole region since the close of the Iroquois episode has from that day to this been slowly raising the northeastern rims of the lake basins so as to cause them to flood more and more the lowlands and valleys at their southwestern extremities, and even to raise the waters so high as to cover some of the deserted shores in those directions. At the same time the waters are leaving their old margins at their northeastern ends, as shown on the map (Fig. 14).

The changes have not been quite simultaneous in the different basins, as the heights of the lake barriers and the rate of terrestrial movements have not been uniform. Thus, in terms of Niagara Falls, it is estimated that the Iroquois Gulf sank below the Iroquois plane about fourteen thousand years ago; but that the

Fig. 15.—Section showing the Tilting of the Iroquois Beach South of Lake Ontario and the St. Lawrence River as far as the Northeast Corner of the Adirondacks.

waters of Lake Huron, which had been emptying by way of the Nipissing Strait for twenty-four thousand years, were turned into Lake Erie only eight thousand years ago. Again, after the waters of the Ontario basin had sunk much below the present western margin of the lakes, they were rising again to near their present height only some three thousand years ago.

Of the absolute amount of rise of the continent we do not know, for the axis of uplift has not been ascertained, but it is evidently in the interior of the continent. The differential rate of elevation varies, being about a foot and a quarter a century in the Niagara district, two feet northeast of Lake Huron, and nearly four feet north of the Adirondacks.

The Future Drainage of the Upper Lakes into the Mississippi River.—With the land rising as at present, it will be only a matter of time until the northeastern rim of Lake Erie will be so high that the drainage must turn into Lake Huron, and thence by way of Lake Michigan and the Chicago Canal into the Mississippi, and Niagara Falls will then end their life history. Some fifteen hundred years ago there was a barrier about a mile north of the present site of the falls that had risen so high in the general regional uplift as to actually cause some of the waters of the upper lakes to overflow where the Chicago Canal is now being built; but, owing to the peculiar buried valley just behind this ridge crossing Niagara River, when the falls had passed the barrier, before the change of outlet of the upper lakes from the Ni-

agara to the Mississippi was completed, the upper lakes were rapidly lowered, and this re-established the life of the Niagara for some time longer. Upon the basis of calculations made it would appear that the change of outlet for the upper lakes from the Niagara to the Mississippi will not be more than another five thousand years hence—to us living a matter of indifference, but only showing how the present days are simply passing events in the history of the lakes. In the meanwhile the waters of Lake Ontario will more and more flood the head of its basin. However, the end of the lakes is so far removed in geological time that, until such great changes in the configuration of the land shall have obtained of which we have no prophetic vision, the lakes will continue to exist.

Age of the Great Lakes.—When the rate of movement of the earth's crust, as determined in the history of Niagara Falls, is applied to the deserted strands of Warren Water and its successsors, it is estimated that since the commencement of the Warren epoch fifty thousand or sixty thousand years have elapsed. This estimate, although based upon the most analytical knowledge obtainable, can, after all, be regarded as only approximate. The time ratio tells us that the lakes are still youthful; although in terms of solar years very old, yet perhaps not older than the human race.

The vicissitudes between the end of the ice age proper and the birth of Warren Water are too little known to enter into any proportional division of time, except that the ice age culminated prior to or at the date of the closing of the old valleys with drift.

The Great Lakes are the most striking feature of the eastern part of the continent, yet what we know of their history has been mostly discovered within the last few years. In this sketch only some of the more important and generalized results have been given. Many of the observations are beyond doubt, but there is plenty of room for students to add to our knowledge and correct our imperfect work. While the history of the lakes can be told with considerable certainty, the attempt at computing their age in terms of solar years has the same fascination, although not so extravagant, as the speculations concerning the antiquity of the earth itself, as the former question probably comes within the human period.

Harvard College Observatory publishes a list of fourteen new variable stars of long period, in addition to those previously announced, which have been discovered by Mrs. Fleming from the examination of Henry Draper memorial photographs. The spectrum of one of these stars is of the fourth type, while all the other stars have spectra of the third type, with the hydrogen lines also bright.

DR. NANSEN'S "THROWING STICK."

By JOHN MURDOCH.

THE report that reached us last February to the effect that Dr. Nansen's adventurous expedition had actually succeeded in reaching the pole, naturally set everybody to reviewing the reasons which led him to adopt his peculiar plan. Among the facts which led him to believe that there was a steady current flowing westward across the pole, there has been frequent mention of an Alaskan *throwing stick* picked up on the southwest coast of Greenland.

Many have doubtless wished to know what a "throwing stick" is, and how it could be thought to give such conclusive evidence of a drift from western America to Greenland. As I had a hand in collecting and working out the evidence that made this little piece of wood so valuable, I propose to try and answer these two questions.

In the first place, a "throwing stick," "throwing board," or "spear thrower," as it is sometimes called, is a contrivance for casting a javelin or harpoon, which is employed by various savage races, such as the Australians, some South American tribes, and especially by the Eskimos, among whom its use is almost universal. Roughly speaking, it is a narrow grooved board a foot or so long, with one end cut into a handle and the other provided with a stud or spur for the butt of the spear to rest against. It is used thus: Grasping the handle as he would a sword, the man fits the shaft of the spear into the groove, with the butt resting against the stud, steadying the spear with the finger. Then, extending his arm and bending back his hand till the spear lies horizontal, he aims at the mark and propels the weapon by a quick forward jerk of the stick. In this way I have seen the Eskimo boys casting their forked javelins at wounded waterfowl.

There is a very large number of Eskimo throwing sticks in the National Museum at Washington, collected from all the different branches of the race. These have been very carefully studied by Prof. Otis T. Mason, one of the curators of the museum, and he has found that these implements differ greatly from each other in their details, while all are made on the same general plan. For instance, one kind will have a plain handle, while another will have projecting pegs, or holes or sockets, to give a firmer hold for the fingers, and so on.

Moreover, he has shown that each division of the Eskimo race has its own pattern of throwing stick, so that, with the help of his illustrations, one can tell, on seeing a throwing stick, whether

it came from Greenland or Hudson Bay, or from Alaska, and even what part of Alaska it came from.

I had spent two years among the Alaskan Eskimos when I was one of the naturalists of the Point Barrow Expedition in 1881–'83, and was especially interested in anything concerning them, particularly about their implements and weapons, as I had made a thorough study of these while preparing the report on the ethnological results of the expedition. Consequently, my curiosity was immediately aroused by a little notice that I accidentally ran across in the Norwegian scientific paper *Naturen*. Speaking of the meeting of the Videnskabs-selskab (Scientific Society) of Christiania, on June 11, 1886, the paper said that the curator of the museum exhibited a throwing stick found among driftwood at Godthaab, Greenland, different from those used in Greenland, but just like those used in Alaska. It was suggested that it had made the same journey as the "Jeannette relics" found at Julianehaab. Now, I have heretofore been inclined to be rather skeptical about the "Jeannette relics," but here, it seemed to me, was something that could be corroborated. I felt sure that if I could see the specimen, or a good drawing of it, I could, with the help of the museum collections (I was employed at the Smithsonian Institution at the time), make absolutely sure whether it was Alaskan or not.

At that time I was in correspondence with Dr. Rink, the famous authority on the Eskimos of Greenland, since deceased, but who was then living in Christiania. So I wrote to him for information, and soon received all that I wanted, with a carefully drawn outline of the specimen. There was no doubt about it at all! It was perfectly Alaskan in pattern, and, moreover, so like specimens from a certain region near Bering Strait that one could almost be certain that it came from there. I at once wrote to Dr. Rink, telling him of my conclusions.

On the strength of my identification of the specimen Dr. Rink published an article in the journal of the Danish Geographical Society, reviewing the whole history of the implement, and in doing so produced more evidence of the authenticity of the "find." It seems that Dr. Rink picked up the specimen himself while serving as an official of the Danish Government at Godthaab. This at once disposes of any suspicion of its being a "plant." It was lying on the beach among the driftwood, and though he and his Eskimo companions recognized it as different from anything used in Danish Greenland, he laid it aside without paying particular attention to it, fancying it came from East Greenland, as it is well known that the driftwood found on the west coast of Greenland comes down the eastern shore with the current and turns up round Cape Farewell. He kept it till 1886,

when the museum at Christiania received a valuable collection of Eskimo implements from East Greenland, collected by the expedition of Captain Holm and Lieutenant Garde. He then gave his "throwing stick" to the museum, as probably coming from the same region. To his surprise, it was found entirely different from the East Greenland implements, and the Norwegian traveler Jakobsen, who had spent many years in Alaska, suggested the resemblance to the Alaskan pattern, which gave rise to the notice that I saw in *Naturen.*

So, from all this, two things were pretty certain: First, that the stick was made in Alaska; and, second, that it was picked up on the beach at Godthaab. Now, how could it have got there? It surely could not have drifted round by way of the Northwest Passage, for that way is barred by such a network of islands that the stick would undoubtedly have been stranded long before it reached Greenland.

Some people have said, "A sailor on an American whaleship might have brought it home with him from Bering Sea, and taken it to Greenland," but any one who is familiar with the customs of American whalemen knows that the same ships never go to the North Pacific and to Davis Strait, and that very few men in the fleet have been to both regions. Moreover, the American whaleships keep over on the other side of the strait. It is very unlikely that the stick could have reached Godthaab in that way. As for the suggestion which has been made that it was dropped somewhere off the Atlantic coast from a ship coming home to New Bedford from Bering Sea, that may be dismissed in a few words. If it were dropped near shore, it would fall into the inshore current and drift south; while if it were dropped farther off, the Gulf Stream would take it to Iceland or Norway.

But it is well known that a current sets north through Bering Strait into the Arctic Ocean, and that north of the strait the current moves steadily westward, as shown by the drift of the Jeannette. It is very easy to believe that the stick drifted in this way, keeping on till it met the current that sweeps down between Iceland and Greenland, and then turned northward again round Cape Farewell. Indeed, it is hard to see how it could have got there otherwise.

So this is the way that the finding of this little piece of wood came to be a link in the chain of evidence that led Dr. Nansen to form his adventurous plan of trusting his stout little vessel to the current which he believed would take him over the very pole.

For my part, I believe that he was right, and that, even if the present rumor turns out to be untrue, there is a very good prospect that he will attain his object.

CO-ORDINATION OF OUR EDUCATIONAL INSTITUTIONS.

By Dr. EDWARD H. MAGILL,
EX-PRESIDENT OF SWARTHMORE COLLEGE.

THE common consensus of thoughtful minds in these latter days has been gradually tending more and more toward the proper co-ordination and correlation of our educational institutions. In a comparatively new country like ours it may naturally be supposed that, as the need for various grades of these institutions has arisen, the want has not always been supplied with a sufficiently careful consideration of the needs of those of other grades, and that, as a result, the general educational interests of the country require some readjustment and reorganization. It should be observed in the beginning that no censure is intended to be applied to any institution or class of institutions for their present status, as this has resulted from the progressive stages of their growth and development, and no sudden or violent change is contemplated or desired. The general outline here to be presented is rather an ideal system for future realization, toward which all may gradually work as their surroundings and circumstances may permit.

Within the past few years a new class of educational institutions has been introduced from abroad, which have received, in their name, the impress of their foreign origin. Of course, we allude to the kindergarten schools, which may now be regarded as the foundation of our present educational system, the culminating point of which is the university. The value of this new importation is no longer seriously questioned by educators, and we cordially accept it here as supplying a need which may be satisfactorily filled by the devotion to it of about three years of the life of a child. In these three years, from the age of three to six, with competent trained teachers, the little ones receive a training of the hand, the eye, the ear, the voice, and the mind that tells powerfully upon all the subsequent years of their school and college life; and the social, moral, and unsectarian religious element of their natures receives in these early years a most profound and lasting impression. With this foundation, entering upon the primary grade at six, this can well be completed in three years, from six to nine, and after these six years of school life the intermediate grade can be well covered in three years more, from the age of nine to twelve. This outline presupposes also the saving of much valuable time by omitting studies which belong to a more mature stage of mental development, and especially much of the time devoted to the foundation of mathematical studies, which should

come chiefly later in the course, language studies taking their just place in the earlier years. We next come to the grammar-school grade, so called, and educators are now beginning to see that this grade, occupying four years, from the age of twelve to sixteen, after the admirable preparation received in the lower grades, should prepare students to enter upon a college course. To this end, too, the requirements for admission to college should be materially lowered instead of being as now too often advanced. This was distinctly announced by Prof. Remsen at Johns Hopkins University in his address before the College Association of the Middle States and Maryland last year, when he made it perfectly evident to all that the best educational interests would be advanced by calling a halt to the colleges which are raising their requirements for admission, thus admitting students younger and graduating them earlier to continue their work in the universities or enter upon the duties of active life. From the age of sixteen to twenty should be devoted to the college course, beginning with few electives in the Freshman year and gradually increasing their number as the course approaches completion. On graduating from college the students should receive their first degrees from these institutions, and all subsequent post-graduate degrees should be earned in and conferred by the universities, in which all college graduates who can devote the additional time and means required should be encouraged to pursue their studies for three or perhaps four years more. As the university course would include the professional courses, students would thus come out at twenty-three or twenty-four years of age equipped thoroughly, so far as our educational institutions can equip them, to cope successfully with the important problems and duties of active life.

It will be seen that for the thorough application of such an outline of study, each institution, of whatever grade, should aim to do its own work most thoroughly and well, and attempt no part of that of an institution of a higher or lower grade. Thus the student should pass from the kindergarten to the primary, from the primary to the intermediate, from the intermediate to the grammar school, from the grammar school to the college, and from the college to the university, entering each institution, as the rule (remarkable exceptions will occur, but they should not change the rule), in the lowest class of that institution, and passing through its entire curriculum in the department selected. No other course than this can assure the successful working of any regularly organized system of instruction.

It is very true that most of our colleges had connected with them in their origin preparatory departments as a necessity of their existence. This necessity has existed, and in some cases still continues to exist, and it is no part of this paper to condemn

such union while circumstances require it. Our universities are of later growth, and are with scarcely an exception in this transition period, with large undergraduate classes. With these, as with the colleges, we have no controversy, for they are doing excellent work, and their circumstances in these earlier stages seem to require this union, which, under other circumstances, we should earnestly deprecate.

We say they are doing excellent work, but this is because of the completeness of their organization in other respects and the able faculties which they employ. But surely they could do worthier work were these faculties free to give their time and attention to graduate students, and no longer hampered and hindered by the instruction of large classes of undergraduates. And the present condition of things is equally a disadvantage to our colleges, whose students, to rival those of universities, aspire to what is quite beyond undergraduate work, and thus wholly overlook the plain line of distinction between a college and a university, consisting as it does so largely of the separating line between *acquisition of the known* and *investigation of the unknown*. And hence it is, too, that a number of colleges, even those of low grade, and *especially* those of low grade, aspire to be called universities. The changes proposed will do away with all this, and colleges and universities will each do better work in their respective fields.

We shall then hail with joy, as advancing the best interests of education in this country, the time when all our universities shall have reached the stage of admitting to their courses no undergraduate students.

It will be seen that to adopt the outline here presented to our educational system it will be needful, in the four grammar-school years (high schools and academies being left out of the scheme), to prepare students properly for entering upon one of the courses in college, the ancient or the modern letters course, or the science course, the requirements for the admission to each being now rapidly equalized by our best colleges. With the nine years of most thorough training in the three earlier grades, from the age of three to twelve, and under teachers who are themselves no mere experimenters, but thoroughly trained to their work, this will be found quite possible, and the preparation will be even better made than under our present system. Of course, the plan involves a complete training in all the grades, including a professional training for teaching in the university before entering upon the responsible position of teacher of the young in any one of the grades, even of the lowest. When this time arrives, teaching as a means of eking out a scanty subsistence, or as a stepping-stone to something higher, with wholly inadequate professional preparation, will be done away. It is, indeed, an expensive method of

supporting those in limited circumstances to intrust them with the delicate and most responsible duties of training the young for their life's work, and so future generations will undoubtedly regard it.

As we said in the beginning, we present this co-ordination and correlation of our educational institutions as an ideal scheme, toward which we should ever aspire, but which we can not expect to see realized by any sudden or violent changes, or, indeed, in full operation within the next quarter of a century. But that something analogous to that which is here presented will be found feasible and practicable, and to harmonize fully with the institutions of this free country of ours, and enable us to attract students from abroad in great numbers instead of sending them, as now, to complete their education in Germany, France, or England, we are most thoroughly convinced. And the more hopefully do we look forward at this time to such a consummation now that the favorite scheme of Washington and our other early Presidents for a great national university at Washington, as the crowning glory of our educational institutions, is likely to be realized at an early day and provided for by an adequate endowment.

FROGS AND THEIR USES.

By R. W. SHUFELDT, M. D.

DURING the last half century or more, and especially during the latter part of this time, Science has made use of a variety of natural objects and living animals in her laboratories to demonstrate the laws and facts of biology. The fundamental phenomena of plant and animal life have been taught by Huxley by placing before his students in the laboratory such material as yeast, and such types of vegetable and animal organization as protococcus, proteus animalculæ, bacteria, molds, stoneworts, ferns, bean plant, bell animalculæ, polyps, mussels, crayfish, and frogs. Foster and Balfour wrote an entire work upon the elements of embryology, using for the purpose only the egg and chick of the common barnyard fowl. For what is true of the hen's egg and its complete development is true in the main for the eggs and development of all forms of animal life, from the highest mammal to the lowest vertebrate known. In the selection of these types for work in the scientific laboratory, teachers have been chiefly guided in their choice by the accessibility of the form selected to the largest number of students of all countries, and by taking an animal of the widest geographical distribution. Thus Cuvier selected the perch as a type for the study

of the structure of fishes; frogs' eggs, tadpoles, and frogs have been almost universally used, while birds and mammals have been largely studied through our investigation of the fowl, the pigeon, and the rabbit. Of course, hundreds upon hundreds of other plant and animal organizations have been most exhaustively worked out, but students always, or very frequently, date back to the manuals upon the biology of these old standbys. Gray's Human Anatomy is a very good example of one of these aids to the study of a single vertebrate species—a monograph, as it were. Some day, Mivart's Cat will hold a similar place as a work of reference. I have already referred above to the use of the frog as an animal whereby the biological student may gain much information; indeed, I do not believe there is a single animal anywhere that, for this or other purposes, has come into more general use. If a common frog be fully studied in all its phases, and a comparative study be made of its entire structure, together with its physiology and habits, the student has made a long stride toward the comprehension of life processes in general, and will find himself landed far within the domain of biology, and very liberally equipped to investigate almost any problem zoölogy may have to offer. In addition to this, ever since physiology came to be a science, frogs have been used by the researchers in that department whereby to demonstrate some of the grandest truths that men have brought to light. Especially is this true with respect to the study of the muscular and nervous systems. Physicists also use them extensively, and the medical expert in experimenting with, or detecting the presence of, a variety of poisons. The circulation of the blood, and the processes of inflammation as seen under the microscope, are now studied by thousands of students in the laboratories the world over, and they are nowhere better seen than in the web of a frog's foot. Some of the more obscure actions of the heart have been made clear by the study of the entire circulatory apparatus of this useful batrachian. The action of woorara in destroying the properties of the motor nerves has been demonstrated by Bernard upon frogs; while Matteucci, by the use of a frog's leg, has shown the contrasted action of the direct and the inverse current. The remarkable experiments of Marshall Hall and of Pflüger, on the reflex action of the spinal cord, where the most delicate animal organization was necessary, were made possible by the use of frogs; while another experimenter has worked out through them the physiological action of strychnine. Indeed, some of the most important facts in physiology have been, and constantly are to-day being, demonstrated upon frogs; and the list of such conquests, and the light they shed upon this most useful kind of knowledge, are altogether too long to enter upon here. Much is to be learned by simply studying the action

of a large, healthy frog in a tub of water. His mode of respiration under such circumstances is a lesson of itself, while the beautiful rhythmic action of his limbs in propelling himself through the water or diving beneath it is almost a complete treatise on the art of swimming. Its action upon land is quite as instructive, and the marvelous leaps and dives of one of these creatures can be studied for a long time with a very considerable degree of profit. Colton, in his Practical Zoölogy, especially invites the student to "notice how the frog sits when at rest," and I can heartily indorse the suggestion. Artists frequently miss it when

Common Bullfrog. One half natural size. From a photograph by Dr. Shufeldt.

they come to represent a frog in the normal attitude of rest; and in my Scientific Taxidermy for Museums I was particular to devote an entire plate to this subject, showing the plaster cast of a large bullfrog taken from one of them in this position. But it is the camera that catches these attitudes the best of all for us, and last summer I paid very considerable attention to the photography of adult living frogs. Most of these results were as fine as could be desired, and one of the best of them is presented here as an example (see figure). If one will take the trouble to compare this with almost any of the pictures of frogs—upon direct lateral aspect—that illustrate the very numerous works upon natural

history, he will be surprised to find how wide many of the latter are of the mark with respect to the attitude the animal really assumes in Nature.

When a frog is at rest in this sitting position he presents us with a number of external characters that are very interesting to study. It will be noticed that the little apertures forming the nostrils open and shut alternately, while at the same time the mouth is closed, and the rising and falling of the skin covering the throat show that a pumping operation is going on. This is just exactly what is taking place, and the air pouring in through the nostrils has to be swallowed in order to be conveyed to the lungs. There being no ribs, the chest can not enter into this respiratory act, so a frog can be easily suffocated by prying its mouth open for a time. The skin in these creatures also forms a very important part of the respiratory apparatus, and a frog can be killed with ease by tying him out in the hot sun, for the cutaneous surface must be kept continually moist in order to have its functions preserved. This is insured in very dry weather by its power to absorb a quantity of water which is stored away for use in an internal nonurinary reservoir, from which receptacle it is excreted over the surface of the body. When one suddenly picks up a frog during the long, dry months of summer, it often voids a quantity of this clear water in a succession of jets. The large, round eye of the bullfrog is peculiar in some respects, for, if we tickle its corneal surface with some light object, as a straw, it will be noticed that the thick upper lid, covered as it is by the common integuments, has very little movement, while on the other hand, as the animal rotates its eyeball inward and beneath this, there at the same time passes up over the organ the thinner, somewhat transparent, lower eyelid. This shield, entirely covering the ball, as it does, reminds one of the structure seen in birds, and called the nictitating membrane. As soon as the irritation is withdrawn, the animal again opens his eye, which, by the way, with its truly beautiful iris, is, in my opinion, one of the most elegant structures seen in Nature. Posterior to and below the eye we meet with a flat, oval area, also covered by the skin, which is the tympanum of the ear. One might possibly mistake this for a thin flat bone in the skin, but this latter tissue in frogs is perfectly smooth and is completely devoid of either scales or osseous plates. There is an American genus of frogs, however (*Ceratophrys*), a few representatives of which form an exception to this rule. If we puncture the eardrum in the frog, it will be found that a fine pig's bristle may be passed by a natural passage through the opening made into the mouth. It goes through the *Eustachian tube*, a canal which is also present in man and other vertebrates, permitting, as it does, the vibrations of the tympanum. The fact

that the frog is devoid of any neck; that its spine makes a hump near the middle of its back; the characters of its two pairs of limbs; and other external features, are all too well known to the intelligent observer and reader to require special description here. There is another thing we must notice, however, and its presence is not generally observed nor appreciated. If we watch carefully at the distal end of the backbone, upon either side of it, it will be seen that the skin pulsates at those points with sufficient force to make it apparent to the eye. These pulsations are performed by the posterior pair of *lymph hearts*. Now, the lymph hearts have nothing to do with the circulation of the blood as performed by the heart, but they, on the other hand, pump the lymph contained in the large lymphatic vessels into the veins. There are two pairs of these lymph hearts—the pair just noticed and an anterior pair, which are below the margin of the shoulder blade, upon either side, and near the lateral processes of the third vertebra. They are muscular organs endowed with the power of contraction, and are extremely important ones in the internal economy of the frog.

In a brief essay, such as I am now writing, it will by no means be practicable to enter upon the extremely interesting subject of the internal structure of the frog. Even to touch upon this ever so lightly would require a small volume to print it. Not a few books are in circulation now devoted largely to the anatomy of these animals, and others no doubt will appear from time to time. A few years ago the distinguished British naturalist, Prof. St. George Mivart, devoted an entire treatise to The Common Frog, and it is truly a most instructive work. In it he describes a number of different kinds of frogs, but what gives the book its special biological significance is that he discusses the life history of these tailless batrachians, and their anatomy and physiology, with a variety of other forms that are either closely affined to them or more or less remotely connected. In summing up, Prof. Mivart shows the differences existing between a frog and a fish, a frog and a reptile, a frog and a bird, a mammal, and so on; and indeed what a frog really is, and he claims it to be "a tailless, lung-breathing, branchiate vertebrate, with four limbs typically differentiated, undergoing a complete metamorphosis, and provided with teeth along the margins of the upper jaw." This last character is one that distinguishes the frogs from the toads, while from other batrachians the frogs are at once separated by the absence of a tail.

In the United States we have at least fifty or sixty different species and subspecies of frogs and tree frogs, belonging to a number of different genera. The typical genus is the genus *Rana*, and to it belongs our common bullfrog (*Rana Catesbiana*), it at

the same time being the species that furnishes the legs so much enjoyed by many epicures. When Huxley gave his biological chapter on these animals, he used the Anglo-continental types, *R. temporaria* and *R. esculenta*, the latter form being the one used for the table in Europe. One of the most interesting species that have been described is the one discovered by Mr. Wallace in Borneo a number of years ago. It has been popularly called the "flying frog," from the fact that it has toes of great length, and these are fully webbed to the tips. If the animal wishes to descend from the top of a high tree it has only to make the leap, and by spreading out its toes it converts its feet into four veritable parachutes, and thus this little aërial batrachian reaches *terra firma* in safety. Among the most curious types are the tree frogs; and Gibson says these "are readily distinguished from all others by having the ends of their toes dilated into knobs or disks, generally provided with a sticky secretion, by means of which they can cling to the leaves and branches of trees. They are small, elegant, and exceedingly active creatures, the males possessing loud voices, of which they make copious use during the breeding season and on the approach of rain." Frogs have from remote times been regarded as weather prophets, and at the present day, in some parts of Germany, the European tree frog (*Hyla arborea*) is used as a barometer. A few of them are placed in a tall bottle provided with miniature ladders, the steps of which they ascend during fine weather, seeking the bottom again on the approach of rain.

Anatomical structures of a variety of kinds are characteristic of different species of frogs, having to do with the *voice organs*. So it is that many croak, some chirp, and some almost bellow. Many emit noises most disagreeable to all ears, while others give vent to sounds that under some circumstances are quite enjoyable. Darwin says, "Near Rio de Janeiro I used often to sit in the evening to listen to a number of little *Hylæ* [tree frogs], which, perched on blades of grass close to the water, sent forth sweet, chirping notes in harmony." This, however, is not the case with another species that occurs in Surinam, also a tree frog, endowed with an extremely disagreeable voice, and, what is worse, they congregate together in great numbers, and then, when they unite in their piping, they have been known to drown the orchestra of the Paramaribo theater.

Frogs live principally upon insects, and these they capture with their peculiarly formed tongue. This organ is soft and extensible, being at the same time covered with a viscid secretion. Anteriorly it is closely attached to the floor of the mouth, while behind it is to a large degree free. The free part is thrust forward when the frog desires to capture an insect, and the latter

sticking to the tongue, it is with marvelous rapidity whipped back to the frog's throat and swallowed. Frogs will also seize some of their prey in other ways, and for this purpose they use their jaws and teeth, which latter are to be found on the palate and upper jaw. I have frequently taken them with hook and line, the former being baited only with a small piece of red flannel. So far as I know at present there is no species of frog that has come to the knowledge of science that possesses a poison gland or apparatus. Some of them, however, secrete from their skin pungent and disagreeable secretions. These are protective in a way, and prevent other animals from preying upon them. In a species of *Hyla* I met with upon the island of Cuba this secretion was so strong as to bring water to the eyes, and upon one occasion when handling one of these creatures and then rubbing my eyes the lids of the latter swelled tremendously, and this condition was only reduced after proper treatment lasting over three or four days. There is another tree frog (*Hyla micans*) in which this secretion of the body is slimy and profuse, and it at the same time possesses luminous properties, which probably also serves to protect the animal from its enemies. There are many beautiful examples of protective mimicry to be seen among frogs, especially among the brown or the green tree frogs, or other arboreal forms that are mottled and shaded with greens, grays, and browns. These species usually feed at night and are still all day, being detected only with difficulty, as they rest upon leaves, limbs, or rocks. Some are brilliantly colored, but they are nonedible varieties, and so their high-colored skins serve them as a protection.

Fossil frogs first occur in the Tertiary, but they become more abundant in the Miocene period.

A SCIENTIFIC way to settle international boundary disputes is suggested by Mr. Hugh Robert Mill, who, speaking of the proposal of the International Geographical Congress for a series of official maps on a uniform scale, says, in Nature: "If the governments of all countries were jointly to take this matter up, survey all unsurveyed lands which they claim, and submit the uncertain boundaries, which are yet uncomplicated by gold mines, to an international commission of geographers, to be decided on the basis of a new map on purely geographical principles, the expense would be many times saved by the security which well-defined frontiers give, and a magnificent contribution to science would be effected."

THE region of the delta of the Yukon is described by W. H. Dall, in his paper on Alaska as it Was and Is, as remarkable for being the breeding place of myriads of waterfowl, some of which are peculiar to the Alaskan region. Nearly a hundred species gather there, and one of them comes all the way from north Australia, by the coasts of China and Japan, to lay its eggs and rear its young in this spot.

THE METRIC SYSTEM.*

By HERBERT SPENCER.

(*With a Letter from Sir Frederick Bramwell.*)

I.

ADVOCATES of the metric system allege that all opposition to it results from "ignorant prejudice." This is far from being the fact. There are strong grounds for rational opposition, special and general; some already assigned and others which remain to be assigned. I may fitly put first a carefully-reasoned expression of dissent from a late man of science of high authority.

In 1863 Sir John Herschel published an essay, in which, after referring to an attempt made during the preceding session to carry through Parliament a bill establishing the French metrical system in this country, and anticipating that the bill (said to have been confirmed in principle) would be again brought forward, he proceeded to contrast that system with a better one to be reached by making a minute modification in our own unit of measure. The following extract will sufficiently indicate the line of his argument:—

Let us now see how far the French metre as it stands fulfills the requirements of scientific and ideal perfection. It professes to be the 10,000,000th part of the quadrant of the meridian passing through France from Dunkirk to Formentera, and is, therefore, scientifically speaking, a local and national and not a universal measure. . . . The metre, as represented by the material standard adopted as its representative, is too short by a sensible and measurable quantity, though one which certainly might be easily corrected.

[In the appendix it is shown that according to the latest measurements the error is 1-163d part of an inch on the metre.]

Sir John goes on to say that "were the question an open one what standard a new nation, unprovided with one and unfettered by usages of any sort, should select, there could be no hesitation as to its adoption (with that very slight correction above pointed out)"; and he then continues—

The question now arising is quite another thing, viz.:—Whether we are to throw overboard an existing, established, and, so to speak, ingrained system—adopt the metre as it stands for our standard—adopt, moreover, its decimal subdivisions, and carry out the change into all its train of consequences, to the rejection of our entire system of weights, measures, and coins. If we adopt the metre we can not stop short of this. It would be a

* Most of the matter in this article appeared originally in the form of unsigned letters n the London Times. The interest in the subject in the United States warrants its republication in the Monthly, with a view to which Mr. Spencer has kindly consented to allow his authorship of the letters to be made known.

standing reproach and anomaly—a change for changing's sake. The change, if we make it, must be complete and thorough. And this is in the face of the fact that England is beyond all question the nation whose com mercial relations, both internal and external, are the greatest in the world, and that the British system of measures is received and used, not only throughout the whole British Empire (for the Indian "Hath" or revenue standard is defined by law to be 18 British imperial inches), but throughout the whole North American continent, and (so far as the measure of length is concerned) also throughout the Russian Empire. . . . Taking commerce, population, and area of soil then into account, there would seem to be far better reason for our Continental neighbors to conform to our linear unit could it advance the same or a better *a priori* claim than for the move to come from our side. (I say nothing at present of decimalization.)

Sir John Herschel then argues that the 10,000,000th part of the quadrant of a meridian, which is the specified length of the metre, is, on the face of it, not a good unit of measure, inasmuch as it refers to a natural dimension not of the simplest kind, and he continues thus :—

Taking the polar axis of the earth as the best unit of dimension which the terrestrial spheroid affords (a better *a priori* unit than that of the metrical system), we have seen that it consists of 41,708,088 imperial feet, which, reduced to inches, is 500,497,056 imperial inches. Now, this differs only by 2,944 inches, or by 82 yards, from 500,500,000 such inches, and this would be the whole error on a length of 8,000 miles which would arise from the adoption of this precise round number of inches for its length, or from making the inch, so defined, our fundamental unit of length.

After pointing out that the calculation required for correlating a dimension so stated with the earth's axis is a shorter one than that required for correlating such dimension with the quadrant of a meridian, Sir John Herschel argues that—

If we are to legislate at all on the subject, then the enactment ought to be to increase our present standard yard (and, of course, all its multiples and submultiples) by one precise thousandth part of their present lengths, and we should then be in possession of a system of linear measure the purest and most ideally perfect imaginable. The change, so far as relates to any practical transaction, commercial, engineering, or architectural, would be absolutely unfelt, as there is no contract for work even on the largest scale, and no question of ordinary mercantile profit or loss, in which one *per mille* in measure or in coin would create the smallest difficulty.

Hitherto I have said nothing about our weights and measures of capacity. Now, as they stand at present, nothing can be more clumsy and awkward than the numerical connection between these and our unit of length.

And then, after pointing out the way in which the slight modification of the unit of linear measure described by him could be readily brought into such relation with the measures of capacity and weight as to regularize them, he goes on :—

And thus the change which would place our system of linear measure

on a perfectly faultless basis would, at the same time, rescue our weights and measures of capacity from their present utter confusion.

In presence of the opinion thus expressed and thus supported by evidence, we ought, I think, to hear nothing more about "ignorant prejudice" as the only ground for opposition to the metric system now being urged upon us. But, before proceeding to give adverse reasons of my own, let me quote a further objection—not, it may be, of the gravest kind, but one which must be taken into account. Writing from Washington, Prof. H. A. Hazen, of the United States Weather Bureau, published in Nature of January 2, this year, a letter of which the following extracts convey the essential points:—

> The metric system usually carries with it the Centigrade scale on the thermometer, and here the whole English-speaking world should give no uncertain sound. In meteorology it would be difficult to find a worse scale than the Centigrade. The plea that we must have just 100° between the freezing and boiling points does not hold; any convenient number of degrees would do. The Centigrade degree (1°·8 F.) is just twice too large for ordinary studies. The worst difficulty, however, is in the use of the Centigrade scale below freezing. Any one who has had to study figures half of which have *minus* signs before them knows the amount of labor involved. To average a column of 30 figures half of which are *minus* takes nearly double time that figures all on one side would take, and the liability to error is more than twice as great. I have found scores of errors in foreign publications where the Centigrade scale was employed, all due to this most inconvenient *minus* sign. If any one ever gets a "bee in his bonnet" on this subject and desires to make the change on general principles it is very much to be hoped that he will write down a column of 30 figures half below 32° F., then convert them to the Centigrade scale, and try to average them. I am sure no English meteorologist who has ever used the Centigrade scale will ever desire to touch it.

But now, having noted these defects, which may perhaps be considered defects of detail, since they do not touch the fundamental principle of the metric system, I propose, with your permission, to show that its fundamental principle is essentially imperfect and that its faults are great and incurable.

II.

In reply to my inquiries, a French friend, member of the Conseil d'Etat, after giving instances of nonconformity to the metric system, ended by saying:—"En adoptant le système métrique décimal, on n'a pas fait disparaître tout à fait les dénominations anciennes, mais on en a fortement réduit l'emploi." [By adopting the decimal metric system, we have not made the old denominations to disappear entirely, but we have greatly reduced their use.]

It is now more than a century since, in the midst of the French Revolution, the metric system was established. Adoption of it

has been in the main compulsory. As French citizens have been obliged to use francs and centimes, so must they have been obliged to use the State-authorized weights and measures. But the implication of the above statement is that the old customs have survived where survival was possible; the people can still talk in sous and ask for fourths, and they do so. Doubtless "ignorant prejudice" will be assigned as the cause for this. But one might have thought that after three generations, daily use of the new system would have entailed entire disappearance of the old, had it been in all respects better.

Allied evidence exists. While in the land of its origin the triumph of the metric system is still incomplete, in one of the lands of its partial adoption, America, the system has been departed from. It will be admitted that men engaged in active business are, by their experience, rendered the best judges of convenience in monetary transactions; and it will be admitted that a Stock Exchange is, above all places, the focus of business where facilitation is most important. Well, what has happened on the New York Stock Exchange? Are the quotations of prices in dollars, tenths, and cents? Not at all. They are in dollars, halves, quarters, eighths; and the list of prices of American securities in England shows that on the English Stock Exchange quotations are not only in quarters and eighths, but in sixteenths and even thirty-seconds. That is to say, the decimal divisions of the dollar are in both countries absolutely ignored, and the division into parts produced by halving, re-halving, and again halving is adopted. Worse has happened. A friend writes:—"When I was in California some twenty years ago the ordinary usage was to give prices in 'bits,' the eighth of a dollar—a 'long bit' was fifteen cents, a 'short bit' was ten cents. If one had a long bit and paid it one got no change—if one gave a short one no supplement was asked." Thus lack of appropriate divisibility led to inexact payments—a retrogression.

Perhaps an imaginary dialogue will most conveniently bring out the various reasons for dissent. Let us suppose that one who is urging adoption of the metric system is put under cross-examination by a skeptical official. Some of his questions might run thus:—

What do you propose to do with the circle? At present it is divided into 360 degrees, each degree into 60 minutes, and each minute into 60 seconds. I suppose you would divide it into 100 degrees, each degree into 100 minutes, and each of these into 100 seconds.

The French have decimalized the quadrant, but I fear their division will not be adopted. Astronomical observations throughout a long past have been registered by the existing mode of measurement, and works for nautical guidance are based upon it. It would be impracticable to alter this arrangement.

You are right. The arrangement was practically dictated by Nature. The division of the circle was the outcome of the Chaldean division of the heavens to fit their calendar: a degree being, within 1-60th, equivalent to a day's apparent motion of the Sun on the ecliptic. And that reminds me that I do not find in your scheme any proposal for redivision of the year. Why do you not make 10 months instead of 12?

A partial decimalization of the calendar was attempted at the time of the French Revolution; a week of ten days was appointed, but the plan failed. Of course, the 365 days of the year do not admit of division into tenths; or, if ten months were made, there could be no tenths of these. Moreover, even were it otherwise, certain deeply-rooted customs stand in the way. Many trading transactions, especially the letting of houses and the hiring of assistants, have brought the quarter-year into such constant use that it would be very difficult to introduce a redivision of the year into tenths.

Just so; and it occurs to me that there is a deeper reason. Ignoring the slight ellipticity of the earth's orbit, a quarter of a year is the period in which the Earth describes a fourth of its annual journey round the Sun, and the seasons are thus determined—the interval between the shortest day and the vernal equinox, between that and the longest day, and so on with the other divisions.

The order of Nature is doubtless against us here.

It is against you here in a double way. Not only the behavior of the Earth, but also the behavior of the Moon conflicts with your scheme. By an astronomical accident it happens that there are 12 full moons or approximately 12 synodic lunations in the year; and this, first recognized by the Chaldeans, originated the 12-month calendar, which civilized peoples in general have adopted after compromising the disagreements in one or other way. But there is another division of time in which you are not so obviously thus restrained. You have not, so far as I see, proposed to substitute 10 hours for 12, or to make the day and night 20 hours instead of 24. Why not?

Centuries ago it might have been practicable to do this; but now that timekeepers have become universal we could not make such a redivision. We might get all the church clocks altered, but people would refuse to replace their old watches by new ones.

I fancy conservatism will be too strong for you in another case—that of the compass. The divisions of this are, like many other sets of divisions, made by halving and re-halving and again halving until 32 points are obtained. Is it that the habits of sailors are so fixed as to make hopeless the adoption of decimal divisions?

Another reason has prevented—the natural relation of the cardinal points. The intervals included between them are necessarily four right angles, and this precludes a division into tenths.

Just so. Here, as before, Nature is against you. The quadrant results from space-relations which are unchangeable and necessarily impose, in this as in other cases, division into quarters. Nature's lead has been followed by mankind in various ways. Beyond the quarter of a year we have the moon's four quarters. The quarter of an hour is a familiar division, and also the quarter of a mile. Though the yard is divided into feet and inches, yet in every draper's shop yards are measured out in halves, quarters, eighths, and sixteenths or nails. Then we have a wine merchant's quarter-

cask, we have the fourth of a gallon or quart, and, beyond that, we have for wine and beer, the quarter of a quart, or half-pint. Even that does not end the quartering of measures, for at the bar of a tavern quarterns of gin, that is quarter-pints of gin, are sold. Evidently we must have quarters. What do you do about them ? Ten will not divide by four.

The Americans have quarter dollars.

And are inconsistent in having them. Just as in France, notwithstanding the metric system, they speak of a quarter of a litre and a quarter of a livre, so in the United States they divide the dollars into quarters, and in so doing depart from the professed mode of division in the very act of adopting it—depart in a double way. For the tenths of a dollar play but an inconspicuous part. They do not quote prices in dollars and dimes. I continually see books advertised at 25c., 75c., $1.25c., $1.75c., and so forth, but I do not see any advertised as $1.3 dimes or 4 dimes, etc. So that, while not practically using the division theoretically appointed, they use the division theoretically ignored.

It may be somewhat inconsistent, but there is no practical inconvenience.

I beg your pardon. If they had a 12-division of the dollar, instead of a 10-division, these prices $1.25 and $1.75 would be $1..3 and $1..9. And not only would there be a saving in speech, writing, and printing, but there would be a saving in calculation. Only one column of figures would need adding up where now there are two to add up; and, besides decreased time and trouble, there would be fewer mistakes. But leaving this case of the dollar, let us pass to other cases. Are we in all weights, all measures of length, all areas and volumes, to have no quarters ?

Quarters can always be marked as ·25.

So that in our trading transactions of every kind we are to make this familiar quantity—a quarter, by taking two-tenths and five-hundredths ? But now let me ask a further question—What about thirds ? In our daily life division by three often occurs. Not uncommonly there are three persons to whom equal shares of property have to be given. Then in talk about wills of intestates one hears of widows' thirds; and in Acts of Parliament the two-thirds majority often figures. Occasionally a buyer will say—"A half is more than I want and a quarter is not enough; I will take a third." Frequently, too, in medicines where half a grain is too much or not enough, one-third of a grain or two-thirds of a grain is ordered. Continually thirds are wanted. How do you arrange ? Three threes do not make ten.

We can not make a complete third.

You mean we must use a makeshift third, as a makeshift quarter is to be used ?

No ; unfortunately that can not be done. We signify a third by ·3333, etc.

That is to say, you make a third by taking 3 tenths, *plus* 3 hundredths, *plus* 3 thousandths, *plus* 3 ten-thousandths, and so on to infinity!

Doubtless the method is unsatisfactory, but we can do no better.

Nevertheless, you really think it desirable to adopt universally for measurements of weight, length, area, capacity, value, a system which gives us only a makeshift quarter and no exact third.

These inconveniences are merely set-offs against the great conveniences.

Set-offs you call them! To me it seems that the inconveniences outweigh the conveniences.

But surely you can not deny those enormous evils entailed by our present mixed system which the proposed change would exclude.

I demur to your assertion. I have shown you that the mixed system would in large part remain. You can not get rid of the established divisions of the circle and the points of the compass. You can not escape from those quarters which the order of Nature in several ways forces on us. You can not change the divisions of the year and the day and the hour. It is impossible to avoid all these incongruities by your method, but there is another method by which they may be avoided.

You astonish me. What else is possible?

I will tell you. We agree in condemning the existing arrangements under which our scheme of numeration and our modes of calculation based on it proceed in one way, while our various measures of length, area, capacity, weight. value, proceed in other ways. Doubtless, the two methods of procedure should be unified; but how? You assume that, as a matter of course, the measure system should be made to agree with the numeration system; but it may be contended that, conversely, the numeration system should be made to agree with the measure system—with the dominant measure system, I mean.

I do not see how that can be done.

Perhaps you will see if you join me in looking back upon the origins of these systems. Unable to count by giving a name to each additional unit, men fell into the habit of counting by groups of units and compound groups. Ten is a bundle of fingers, as you may still see in the Roman numerals, where the joined fingers of one hand and the joined fingers of the two hands are symbolized. Then, above these, the numbering was continued by counting two tens, three tens, four tens, etc., or 20, 30, 40 as we call them, until ten bundles of ten had been reached. Proceeding similarly, these compound bundles of tens, called hundreds, were accumulated until there came a doubly compound bundle of a thousand; and so on. Now, this process of counting by groups and compound groups, tied together by names, is equally practicable with other groups than 10. We may form our numerical system by taking a group of 12, then 12 groups of 12, then 12 of these compound groups; and so on as before. The 12-group has an enormous advantage over the 10-group. Ten is divisible only by 5 and 2. Twelve is divisible by 2, 3, 4, and 6. If the fifth in the one case and the sixth in the other be eliminated as of no great use, it remains that the one group has three times the divisibility of the other. Doubtless it is this great divisibility which has made men in such various cases fall into the habit of dividing into twelfths. For beyond the 12 divisions of the zodiac and the originally associated twelvemonth, and beyond the twelfths of the day, and beyond those fourths—submultiples of 12—which in sundry cases Nature insists upon and which in so many cases are adopted in trade, we have 12 ounces to the pound troy, 12 inches to the foot, 12 lines to the inch, 12 sacks to the last; and of multiples of 12 we have 24 grains to the pennyweight, 24 sheets to the quire. Moreover, large sales of small articles are habitually made by the gross (12 times 12) and great gross ($12 \times 12 \times 12$). Again, we have made our multiplication table go up to 12 times 12, and we habitually talk of dozens. Now,

though these particular 12-divisions are undesirable, as being most of them arbitrary and unrelated to one another, yet the facts make it clear that a general system of twelfths is called for by trading needs and industrial needs; and such a system might claim something like universality, since it would fall into harmony with those natural divisions of twelfths and fourths which the metric system necessarily leaves outside as incongruities.

But what about the immense facilities which the method of decimal calculations gives us? You seem ready to sacrifice all these?

Not in the least. It needs only a small alteration in our method of numbering to make calculation by groups of 12 exactly similar to calculation by groups of 10; yielding just the same facilities as those now supposed to belong only to decimals. This seems a surprising statement; but I leave you to think about it, and if you can not make out how it may be I will explain presently.

III.

The promised explanation may most conveniently be given by reproducing, with various alterations and additions, a letter I wrote about the matter last November twelvemonth to a distinguished man of science. Omitting the name, the letter ran thus:—

The inclosed memoranda concerning advantages to be derived from the use of 12 as a fundamental number were written more than 50 years ago, and have since been lying unused among my papers.

I send them to you because you have lately been expressing a strong opinion in favor of the metric system, and of course your opinion will weigh heavily. From the days when the accompanying memoranda were set down I have never ceased to regret the spreading adoption of a system which has such great defects, and I hold that its universal adoption would be an immense disaster.

Of course I do not call in question the great advantages to be derived from the ability to carry the method of decimal calculation into quantities and values, and of course I do not call in question the desirableness of having some rationally originated unit from which all measures of lengths, weights, forces, etc., shall be derived. That as promising to end the present chaos the metric system has merits goes without saying. But I object to it on the ground that it is inconvenient for various purposes of daily life, and that the conveniences it achieves may be achieved without entailing any inconveniences.

One single fact should suffice to give us pause. This fact is that, notwithstanding the existence of the decimal notation, men have in so many cases fallen into systems of division at variance with it, and especially duodecimal division. Numeration by tens and multiples of ten has prevailed among civilized races from early times. What then has made them desert this mode of numeration in their tables of weights, measures, and values? They can not have done this without a strong reason. The strong reason is conspicuous—the need for easy division into aliquot parts. For a long period they were hindered in regularizing their weights and measures by the circumstance that these had been derived from organic bodies and organic lengths—the carat and grain, for instance, or the cubit, foot, and digit. Organic weights and lengths thus derived were not defi-

nite multiples one of another, and where they were approximate multiples the numbers of these were irregular—would not conform to any system. But there early began, as among the Chaldeans, arrangements for bringing these natural measures into commensurable relations. By sexagesimal divisions (60 being the first number divisible both by 10 and 12), the Babylonian cubit was brought into relation with the Babylonian foot. The stages of change from nation to nation and from age to age can not, of course, be traced, but it suffices to recognize the fact that the tendency has been toward systems of easily-divisible quantities—the avoirdupois pound of 16 ounces, for instance, which is divisible into halves, into quarters, into eighths. But, above all, men have gravitated toward a 12-division, because 12 is more divisible into aliquot parts than any other number—halves, quarters, thirds, sixths—and their reason for having in so many cases adopted the duodecimal division is that this divisibility has greatly facilitated their transactions. When counting by twelves instead of by tens, they have been in far fewer cases troubled by fragmentary numbers. There has been an economy of time and mental effort. These practical advantages are of greater importance than the advantages of theoretical completeness. Thus, even were there no means of combining the benefits achieved by a method like that of decimals with the benefits achieved by duodecimal division, it would still be a question whether the benefits of the one with its evils were or were not to be preferred to the benefits of the other with its evils—a question to be carefully considered before making any change.

But now the important fact, at present ignored, and to which I draw your attention, is that it is perfectly possible to have all the facilities which a method of notation like that of decimals gives, along with all the facilities which duodecimal division gives. It needs only to introduce two additional digits for 10 and 11 to unite the advantages of both systems. The methods of calculation which now go along with the decimal system of numeration would be equally available were 12 made the basic number instead of 10. In consequence of the association of ideas established in them in early days and perpetually repeated throughout life, nearly all people suppose that there is something natural in a method of calculation by tens and compoundings of tens. But I need hardly say that this current notion is utterly baseless. The existing system has resulted from the fact that we have five fingers on each hand. If we had had six on each there would never have been any trouble. No man would ever have dreamt of numbering by tens, and the advantages of duodecimal division with a mode of calculation like that of decimals would have come as a matter of course.

Even while writing I am still more struck with the way in which predominant needs have affected our usages. Take our coinage as an example. Beginning at the bottom we have the farthing (¼ penny), the halfpenny and penny (or one-twelfth of a shilling); next we have the threepenny piece (¼ shilling), the 6*d.* piece (½ shilling), and the shilling; and then above them we have the eighth of a pound (2*s.* 6*d.*), the quarter of a pound (5*s.*), and half-pound (10*s.*). That is to say, daily usage has made us gravitate into a system of doubling and again doubling and redoubling; and when until recently there existed the 4*d.* piece we had the convenience of a third as well as a half and a quarter—a convenience which would have been retained but for the likeness of the 3*d.* and 4*d.* coins. And observe

that this system of multiples and sub-multiples has its most conspicuous illustration in the commonest of all processes—retail payments—and that, too, in the usages of a nation which is above all others mercantile.

Now it seems to me that the two facts—first, that in early days men diverged from the decimal division into modes of division which furnished convenient aliquot parts, and, second, that where, as in America, the decimal system has been adopted for coinage, they have in the focus of business fallen into the use of aliquot parts in spite of the tacit governmental dictation—not only prove the need for this mode of division, but imply that, if the metric system were universally established, it would be everywhere traversed by other systems. To ignore this need, and to ignore the consequences of disregarding it, is surely unwise. Inevitably the result must be a prevention of the desired unity of method; there will be perpetual inconveniences from the conflict of two irreconcilable systems. [At the time this prophecy was made, I did not know that in California the "long bits" and "short bits" of the dollar already illustrated this conflict of systems and its evils.]

I fully recognize the difficulties that stand in the way of making such changes as those indicated—difficulties greater than those implied by the changes which adoption of the metric system involves. The two have in common to overcome the resistance to altering our tables of weights, measures, and values; and they both have the inconvenience that all distances, quantities, and values named in records of the past must be differently expressed. But there would be further obstacles in the way of a 12-notation system. To prevent confusion different names and different symbols would be needed for the digits, and to acquire familiarity with these, and with the resulting multiplication table, would, of course, be troublesome; perhaps not more troublesome, however, than learning the present system of numeration and calculation as carried on in another language. There would also be the serious evil that, throughout all historical statements, the dates would have to be differently expressed; though this inconvenience, so long as it lasted, would be without great difficulty met by inclosing in parentheses in each case the equivalent number in the old notation.

But, admitting all this, it may still be reasonably held that it would be a great misfortune were there established for all peoples and for all time a very imperfect system when with a little more trouble a perfect system might be established.

Thus far the letter. And now let me sum up the evidence. Professedly aiming to introduce uniformity of method, the metric system can not be brought into harmony with certain unalterable divisions of space nor with certain natural divisions of time, nor with the artificial divisions of time which all civilized men have adopted. As 10 is divisible only by 5 and 2 (of which the resulting fifth is useless), its divisibility is of the smallest; and having only a makeshift fourth and no exact third, it will not lend itself to that division into aliquot parts so needful for the purposes of daily life. From this indivisibility it has resulted that, though men from the beginning had in their ten fingers the decimal system ready made, they have, in proportion

as civilization has progressed, adopted, for purposes of measurement and exchange, easily divisible groups of units; and in a recent case, where the 10-division of money has been imposed upon them, they have, under pressure of business needs, abandoned it for the system of division into halves, quarters, eighths, sixteenths. On the other hand, the number 12 is unique in its divisibility—yields two classes of aliquot parts—and for this reason has been in so many cases adopted for weights, measures, and values. At the same time it harmonizes with those chief divisions of time which Nature has imposed upon us and with the artificial divisions of time by which men have supplemented them; while its sub-multiple, 4, harmonizes with certain unalterable divisions of space, and with those divisions into quarters which men use in so many cases. Meanwhile, if two new digits for 10 and 11 be used, there arises a system of calculation perfectly parallel to the system known as decimals, and yielding just the same facilities for computation—sometimes, indeed, greater facilities, for, as shown in the memoranda named in the above letter, it is even better for certain arithmetical processes.

Do I think this system will be adopted? Certainly not at present—certainly not for many generations. In our days the mass of people, educated as well as uneducated, think only of immediate results; their imaginations of remote consequences are too shadowy to influence their acts. Little effect will be produced upon them by showing that, if the metric system should be established universally, myriads of transactions every day will for untold thousands of years be impeded by a very imperfect system. But it is, I think, not an unreasonable belief that further intellectual progress may bring the conviction that since a better system would facilitate both the thoughts and actions of men, and in so far diminish the friction of life throughout the future, the task of establishing it should be undertaken.

Hence I contend that adoption of the metric system, while it would entail a long period of trouble and confusion, would increase the obstacles to the adoption of a perfect system—perhaps even rendering them insuperable—and that, therefore, it will be far better to submit for a time to the evils which our present mixed system entails.

P. S.—A mathematician and astronomer, who writes—"I am much interested in your letters and agree with almost everything," makes some comments. He says:—"It has always been an astonishing thing to me that the advocates of decimalization do not perceive that its only advantage is in computation. In every other process it is a detriment." Concerning the 12-notation, he remarks that "the advantages are notorious to all mathematicians." Apparently less impressed than I am with the advance

of knowledge from uncivilized times to our own and the breaking down of habits, now going on with accelerated rapidity, he does not share the expectation that the 12-notation "will ever be adopted in practice," the obstacles to the change being too great. But without opposing the metric system as threatening to stand in the way of a more perfect system, he opposes it as intrinsically undesirable, saying:—"I think that all that can be done is to make our coinage and measures as little decimal as possible, and our computation as decimal as may be."

IV.

From one who every month has to act as auditor, I have received a letter in which he says: "I had to go over more than £20,000 of accounts yesterday, and was very thankful that it was not in francs."

This statement, coming from a man of business, has suggested to me the question, By whose advice is it that the metric system of weights, measures, and values is to be adopted? Is it by the advice of those who spend their lives in weighing and measuring and receiving payments for goods? Is it that the men who alone are concerned in portioning out commodities of one or other kind to customers, and who have every minute need for using this or that division or subdivision of weights or measures, have demanded to use the decimal system? Far from it. I venture to say that in no case has the retail trader been consulted. There lies before me an imposing list of the countries that have followed the lead of France. It is headed Progress of the Metric System. It might fitly have been headed Progress of Bureaucratic Coercion. When, fifty years after its nominal establishment in France, the metric system was made compulsory, it was not because those who had to measure out commodities to customers wished to use it, but because the Government commanded them to do so; and when it was adopted in Germany under the Bismarckian *régime*, we may be sure that the opinions of shopkeepers were not asked. Similarly elsewhere, its adoption has resulted from the official will and not from the popular will.

Why has this happened? For an answer we must go back to the time of the French Revolution, when scientific men were intrusted with the task of forming a rational system of weights, measures, and values for universal use. The idea was a great one, and, allowing for the fundamental defect on which I have been insisting, it was admirably carried out. As this defect does not diminish its great convenience for scientific purposes, the system has been gradually adopted by scientific men all over the world; the great advantage being that measurements registered by a scientific man of one nation are without any trouble made intelli-

gible to those of other nations. Evidently moved by the desire for human welfare at large, scientific men have been of late years urging that the metric system should be made universal, in the belief that immense advantages, like those which they themselves find, will be found by all who are engaged in trade. Here comes in the error. They have identified two quite different requirements. For what purpose does the man of science use the metric system? For processes of measurement. For what purpose is the trader to use it? For processes of measurement *plus* processes of exchange. This additional element alters the problem essentially. It matters not to a chemist whether the volumes he specifies in cubic centimetres or the weights he gives in grammes are or are not easily divisible with exactness. Whether the quantities of liquids or gases which the physicist states in litres can or can not be readily divided into aliquot parts is indifferent. And to the morphologist or microscopist who writes down dimensions in subdivisions of the metre, the easy divisibility of the lengths he states is utterly irrelevant. But it is far otherwise with the man who, all day long, has to portion out commodities to customers and receive money in return. To satisfy the various wants of those multitudes whose purchases are in small quantities, he needs measures that fall into easy divisions and a coinage which facilitates calculation and the giving of change. Ask him to do his business in tenths, and he will inevitably be impeded.

"But you forget that the metric system is approved by many mercantile men, and that its adoption is urged by the chambers of commerce." No, I have not forgotten; and if I had I should have been reminded of the fact by the fears now expressed that our commerce will suffer if we do not follow in the steps of sundry other nations. The fears are absurd. French and German merchants, when sending goods to England, find no difficulty in marking them or invoicing them in English measures. And if English merchants imply that they are too stupid to follow the example in a converse way, they can scarcely expect to be believed. Surely the manufacturers who supply them with piece goods will make these up in so many metres instead of in so many yards, if asked to do so; and similarly in all cases. Or, if not, it needs but a table on the wall in the clerk's office, giving in parallel columns the equivalents of quantity in English denominations and French denominations, to make easy the needful invoicing and labeling. But it is not on this flimsiest of reasons that I wish chiefly to comment. The fact here to be specially emphasized is that merchants are not in the least concerned with the chief uses of the metric system. Their bales and chests and casks contain large quantities—dozens of yards, hundredweights, gallons. They do not deal with subdivisions of these. Whether

the retailer is or is not facilitated in portioning out these large quantities into small quantities is a question having no business interest for them. More than this is true. Not only have they never in their lives measured out fractional amounts in return for small sums of money, but they have rarely witnessed the process. Their domestic supplies are obtained by deputy, usually in considerable quantities; and neither behind the counter nor before it have they with any frequency seen the need for easy divisibility into aliquot parts. Their testimony is supposed to be that of practical men, while in respect of the essential issue—the use of weights and measures for retail trade—they have had no practice whatever.

See, then, the strange position. The vast majority of our population consists of working people, people of narrow incomes, and the minor shopkeepers who minister to their wants. And these wants daily lead to myriads of purchases of small quantities for small sums, involving fractional divisions of measures and money—measuring transactions probably fifty times as numerous as those of the men of science and the wholesale traders put together. These two small classes, however, unfamiliar with retail measuring transactions, have decided that they will be better carried on by the metric system than by the existing system. Those who have no experimental knowledge of the matter propose to regulate those who have! The methods followed by the experienced are to be rearranged by the inexperienced!

To the Editor of the Times.

SIR: I am one of those who believe that this system, in conjunction with its inevitable concomitant, decimals, is one which is absolutely incompatible with mental arithmetic, and that, whatever theorists may say to the contrary, it demands more figures to perform most ordinary sums than does our present system, when rightly applied; and, further, is much more likely to lead to error, owing to the very multiplicity of figures, and, above all, to the common error in placing the decimal point.

But, without further obtruding my views, which I am aware will carry but little weight with your readers, I desire to be allowed to send to you an extract from the Comte de Montholon's book, vol. iv, pages 213 to 218, stating the views of the First Napoleon on this point, thinking that probably this will be read with interest.

I send also an extract from "Littré," giving the meaning of the (to me) unusual term "*nombre complexe*," for which I know of no English equivalent.

I am, sir, your obedient servant,

FREDERICK BRAMWELL.

Nombre complexe (or compound number). Littré gives the following definition of it under "Complexe": "Complexe ; Terme d'arithmétique. Nombre complexe, nombre composé d'unités différentes, comme nos anciennes mesures : 1 toise, 5 pieds, 9 pouces ; 25 livres, 13 sous, 6 deniers, sont des nombres complexes." (*Translation:* "Arithmetical term, compound number; a number composed of different kinds of units, like our old measures: 1 toise, 5 feet, and 9 inches; 25 livres, 13 sous, and 6 deniers are compound numbers."

(*Translation.*)

Memoranda for use in a History of France under Napoleon, written at St. Helena by General Comte de Montholon, Volume IV, pp. 213–218:

The need of uniformity in weights and measures has been felt in all ages; the States-General have pointed it out many times. This good gift was expected from the Revolution. A sufficient simple law to assure it might have been drawn up in twenty-four hours, adopted, and put in operation in all France in less than a year. All that was needed was to make the unit of weights and measures of the city of Paris common to all the provinces. The Government and the artists have used them for many centuries; by sending the standards into all the communes, and enjoining the administrative officers and the courts from admitting any others, the benefit would have been operative without effort, without restriction, and without coercive laws. Instead, geometricians and algebraists were consulted upon a question which was of administrative jurisdiction. They thought that the unit of weights and measures should be deduced from a natural constant, so that it might be adopted by all nations. They thought it was not enough to provide for the advantage of forty million men; they wanted the whole universe to participate in it. They found that the metre was an aliquot part of the meridian; they made the demonstration of it and proclaimed it in an assembly composed of French, Italian, Spanish, and Dutch geometricians.

From that time a new unit of weights and measures was decreed, which did not square with the rules of the public administration, or with the tables of dimensions of all the arts, or with those of any existing machines.

There was no advantage in extending this system to the whole universe. That was, besides, impossible. The national spirit of the English and Germans was opposed to it. That Gregory VII, in reforming the calendar, made it common to all Europe, was because the reform pertained to religious ideas, and was not made by a nation, but by the power of the Church.

Meanwhile the good of present generations was sacrificed to abstractions and vain hopes, for to make an old nation adopt a new unit of weights and measures it is necessary to make over again all the rules of public administration, all the calculations of the arts—a task to frighten reason. The new unit of weights and measures, whatever it may be, has an ascending and descending scale which does not accord in simple numbers with the scale of the unit of weights and measures which has been used for centuries by the Government, men of science, and artists.

No transfer can be made from one nomenclature to the other, because what is expressed by the simplest number in the old system will have to take a composite number in the new. It will be necessary, then, to increase or diminish the amount by some fraction, so that the space or the

weight expressed in the new nomenclature shall be in simple numbers. Thus, for example, the ration of the soldier is expressed in the old nomenclature as twenty-four ounces; this is a very simple number. Translated into the new nomenclature, it gives seven hundred and thirty-four grammes and two hundred and fifty-nine thousandths. It is, then, evident that it is necessary to increase or diminish the weight so as to make seven hundred and thirty-four or seven hundred and thirty-five grammes.

All the component pieces or lines of architecture; all the pieces and tools used in watch-making, jewelry, book-selling, and all the arts; all instruments and machines, have been devised and calculated in the old nomenclature, and are expressed in simple numbers, which can be translated in the new system only into numbers composed of five or six figures. It will be necessary, therefore, to do everything over again.

The scientific men also conceived another idea wholly foreign to the benefit of unity of weights and measures: they adopted the decimal numeration, taking the metre for the unit; they suppressed all complex numbers. Nothing is more contrary to the organization of the mind, the memory, and the imagination. A toise, a foot, an inch, a line, a point, are fixed portions of extension, which the imagination conceives independently of their relations to one another; if, then, we ask for the third of an inch, the mind goes into instant operation. The length called an inch is divided into three parts. By the new system, on the contrary, the mind has, not to divide an inch into thirds, but a metre into a hundred and eleven parts. The experience of all ages had made the difficulty of dividing a space or a weight by more than twelve so evident that a new name was created for each of the divisions. If the twelfth of an inch was asked for—the operation was already performed—we had the measure called the line.

The decimal numeration was applied to all the complex numbers as a unit; and if we wanted a hundredth of a point, a hundredth of a line, a hundredth was written. By the new system, if we want to express a hundredth of a line, we have to consider its relation to the metre, and this involves us in an infinite calculation.

The divisor 12 was preferred to the divisor 10, because 10 has only two factors, 2 and 5, while 12 has four factors, 2, 3, 4, and 6.

It is true that the decimal system, generalized and adapted to the metre as the unit, gives facilities to astronomers and calculators; but these advantages are far from compensating for the inconvenience of rendering thought more difficult. The prime characteristic of every method should be that of aiding the conception and the imagination, of facilitating the memory, of giving more force to the thought.

The compound numbers are as old as man, because they are in the nature of his organization, quite as it is in the nature of the decimal numeration to adapt itself to every unit, to every complex number, and not exclusively to one unit.

Finally, they use Greek roots, and that augments the difficulties; the denominations, which may be useful for men of science, were not good for the people. The system of weights and measures was one of the greatest achievements of the Directory. Instead of letting time do its work, and being satisfied to encourage the new system by means of example and fashion, it made coercive laws and executed them vigorously.

The merchants and the citizens were vexed by affairs indifferent in

themselves, and this contributed to make unpopular an administration which put itself away from the wants and the reach of the people, violently broke with their usages, habits, and customs, as a Greek or Tartar conqueror might have done, who with uplifted rod intended to compel obedience to all his desires based upon his own prejudices and interests, regardless of those of the conquered.

The new system of weights and measures will be a subject of embarrassment and difficulties for many generations; and the first commission charged with the verification of the measure of the meridian will probably find that there are some corrections to be made. This is tormenting the people with caprices.

THE MONETARY PROBLEM.

By LOGAN G. McPHERSON.

AS has been perceived, it is by the constant exchange of human effort that human welfare is promoted, and therefore is necessarily a means whereby each portion of effort contributing to the total welfare may be measured and rewarded. This means or medium of exchange is money, and its development has been as follows:

First, there was barter, or the direct exchange of commodity for commodity. Next, there was the disposal of commodities in exchange for a generally acceptable and readily disposed of commodity, the first form of money. By reason of their suitability, one or another of the metals becomes generally used as such a commodity, and as commodities are exchanged in larger volume, metals of the greatest value are coined. Then, there is the use of paper promises to pay coin issued from various sources and accepted to the extent that their security is believed in. Then these representatives of coin gradually pass into paper representatives of value, as evidenced by the result of effort, and by means of banks paper representatives of value are offset against other paper representatives of value without the intervention of coin at all.

But the progression through barter and the use of metals as money to the use of paper representatives of value has not been uniform either in time or place. There are still tribes in out-of-the-way regions who make rude exchanges by barter, and there are races between the individuals of whom the exchange of effort is uncertain and irregular, whose currencies are composed almost exclusively of lead, tin, copper, and iron. There are not only marked points of difference between the monetary systems of different nations, but in many instances one and the same nation still uses coins of different metals, of different weights, and different degrees of fineness, the values of which are not in definite

regular ratio, and notably in the United States there are paper currencies issued from different sources and resting upon different bases.

The money in circulation in the United States amounts to between one and a half and one and three-quarter billions of dollars, divided approximately as follows: Nickel and copper coins, twenty millions of dollars; silver coin, one hundred and twenty millions of dollars; gold coin, four hundred and eighty millions of dollars; paper currency, one thousand millions of dollars.

Statistics gathered by the Comptroller of the Currency show that, of the receipts of national banks, checks form an average of about ninety per cent, only about ten per cent being composed of paper currency and coin. Other statistics, also gathered by the Comptroller of the Currency, show that in retail transactions throughout the United States the medium of exchange is composed, on an average, to the extent of about forty per cent of checks and sixty per cent of paper currency and coin. The smaller retail transactions are effected almost entirely by the use of coin; as the transactions become of greater value, the more does paper currency enter into them; as their value further increases, the greater is the use of checks, and transactions of magnitude between different localities are settled by drafts and bills of exchange.

This progression in the medium of exchange, corresponding with the progression in value of coexistent transactions, agrees with the progression in the medium of exchange in correspondence with the progression in value of transactions, as they have developed throughout history, and makes manifest the fact that the most important monetary factors at present are paper representatives, of value consisting, first, of bank notes or government notes circulating generally as currency, issued under government regulation, and secured upon widely known bases; second, of checks, drafts, promissory notes, bills of exchange, and other instruments depending for their security upon the resources of the drawers and indorsers, the extent of which is not generally known.

As these paper representatives of value form by far the greater portion of the medium of exchange, the most important point of the monetary problem is raised by the question—

How may paper representatives of value be secured, to most satisfactorily meet the requirements of a medium of exchange?

Let the conditions incident to the issue and acceptance of a paper representative of value in a simple case be considered. When, a few years ago, a humble laborer, bereft of home, property, and family by the Johnstown flood, applied to the manager of a Pittsburg mill for work, he was provided with some immediate

necessaries in exchange for his duebill, which called for five dollars. That duebill was practically his promise to expend effort in the service of the mill, to balance the efforts of others expended in producing the necessities provided him, and the manager accepted it in the belief that the laborer's effort to that value would be forthcoming. That duebill was returned to the laborer the next pay day as part of his wages, its purpose having been effected without the use of coin or bullion.

It will be perceived that the duebill, the representative of value in this instance, was accepted—

1. Because the acceptor believed in the ability of the issuer to produce desired result of human effort to the value called for by it.

2. Because the acceptor believed in the intention of the issuer to produce desired result of human effort to the value called for by it.

3. Because the value of the effort called for was definitely understood between the issuer and the acceptor, the unit of the measure of that value being one dollar, and the total measure of that value five dollars.

The duebill could not have been given general circulation, because not many people would have been confident that its value would be forthcoming. This lack of confidence may have proceeded from ignorance of the ability and intention of the issuer through lack of acquaintance with him, or from doubt in the minds of those acquainted with him as to his ability and intention. If, however, the promise of the laborer had been re-enforced by the promise of the manager that he would make its value good if the laborer did not, the duebill doubtless could have been given a certain circulation among those having knowledge of the manager's honesty and resources, and believing in the genuineness of his indorsement.

In other communities, however, among persons knowing neither the laborer nor the manager, circulation for the duebill could not have been expected. A representative of value, therefore, to have wide circulation, must be issued and assured from a source widely known to be able and honest in the intention to produce the value of effort to the amount for which it calls.

As it is by transition from the use of coin that paper representatives of value come into use, they are at first usually direct representatives of coin, and are generally accepted on the assurance that they can readily be exchanged for the amount of coin for which they call. This assurance is nearly always given by a government directly or indirectly. If it be required that gold, to the full value specified by circulating notes, be held as a basis for a paper currency, such a currency will never be adequate to supply

the monetary needs of so vast a nation as the United States. It is doubtful that even the vast increase, both present and prospective, in the production of gold will yield a supply, the proportion of which coming to the United States would be sufficient for its monetary needs under such a requirement. To the evils of a paper currency issued against silver, reference will be made hereinafter.

If paper currency apparently based upon gold be issued to a value greatly in excess of that of the gold held for its redemption, the excess of the currency above the gold, in the absence of other guarantee of its security, is speculative and unstable. If a guarantee of its security other than gold or other metal in coin or bullion be given, a new factor enters into the monetary sphere.

The United States bonds are promises to pay, based upon the ability of the Government of the United States to obtain the result of human effort to the extent of their value by the power of taxation; and as a United States national bank is required to deposit numbers of these bonds as a basis for the bank notes issued by it, the security for these notes is really the Government's power of taxation, or ultimately the result of human effort elicited by the use of that power. A considerable portion of the security for the notes of the Bank of England consists of indebtedness of the nation to the bank; and the Dominion notes of Canada are largely based upon the Government's indebtedness. A new factor succeeding and supplementing gold as the basis for monetary issue is therefore the assurance of the result of human effort to the extent necessary to maintain the expressed value of the currency.

To perceive that a paper representative of value so secured will perform every function of a coin of equal value needs only an instant's reflection. A five-dollar national bank note, for example, one of hundreds of such notes, drawn from a bank by the paymaster of a woolen mill, may be paid to one of the operatives as the measure and reward in part of the expenditure of his effort in guiding the loom. It may be paid by him to his grocer, thereby measuring and rewarding in part the efforts of men expended in producing and bringing to him potatoes, flour, coffee, sugar, bacon. It may be paid by the grocer to his landlord, and so measure and reward him in part for effort expended under his direction in erecting and finishing the building containing the grocery. It may be paid by the landlord to a servant, as the measure and reward of effort expended in keeping his house clean and preparing food for his family. It may be given by her to a shoe dealer, measuring and rewarding in part the efforts of men expended in killing cattle, tanning hides, working them into shoes, and bringing the shoes to the store whence she obtained them.

And thus that five-dollar bill may go round and round until it is deposited by some recipient in a bank, whence it may emerge and perform round after round of other service, and so on perhaps for years. In all its circuits, the thought of exchanging it for gold or silver may not enter the mind of a single person through whose hands it passes. It measures and rewards human effort; it is generally accepted because its recipients have ample confidence in the assurance of the bank, guaranteed by the Government that its value, as expressed on its face, will be preserved and maintained. They have confidence in the ability of the issuer to that end; they have confidence in the intention of the issuer to that end. The measure of value expressed by five dollars is definitely understood by them.

If other proof is required that neither coin nor bullion is essentially necessary to effect the exchange of human effort, attention need only be called to the emergency currency brought into existence by the currency famine of August and September, 1893. Clearing-house certificates, clearing-house duebills, certified checks, pay checks, negotiable certificates of deposit, bond certificates, grain-purchase notes, store orders, improvement fund orders, teachers' warrants and shingle scrip, sprang into being and measurably facilitated the exchange of human effort in many localities, especially in the West and Southwest, where mills, mines, and stores would have closed had there been nothing to take the place of the ordinary currency of the nation. These instruments in each instance were paper representatives of value as evidenced by the result of human effort; they each attained a circulation among those believing in the intention and ability of the issuers to make their expressed value good.

As it is by use of the results of human effort that further effort is made possible, as it is to obtain the result of human effort that human effort is put forth, what more logical, what more inevitable, than that the medium whereby human effort is exchanged, whereby it is measured and rewarded, be based upon the results of human effort? That is, it is by the exchange of human effort that we are fed and housed and clothed. It is by use of houses, food, and clothing that we are enabled to construct machines, build bridges and railroads. By the use of machines, bridges, and railroads other houses are built, other food, other clothing is prepared and distributed. To obtain houses, food, and clothing our effort is put forth. The medium which rewards us should assure us the possession of that for which we toil. As it is human effort that supplies human wants, and as human effort is known by its results, the medium of exchange and measure of value should be based directly upon the results of human effort; that is, effort of a certain quantity and quality, as evidenced by

its result, should be rewarded by that which, under the law of supply and demand, will assure the possession of the result of other human effort of a certain quantity and quality in an acceptable form. Human effort should be measured by human effort, not by any one commodity, however precious, the supply of which is inconstant; human effort should be rewarded by human effort, not by any one commodity, however precious, the value of which is unstable. The attainment of this end is the final step of that evolution which began with barter, and through the use of coin and paper representatives of coin we are taking that step so gradually that we notice not its meaning.

Obviously it must not be that the assurance of reward be based upon the result of human effort, as evidenced solely by any one commodity. Cloth, corn, leather, each varies in quantity from year to year, and the supply is not always in the same ratio to the demand—that is, neither one of these commodities is of a definite value that is permanent. This same objection applies, but in greater degree, to both gold and silver. The assurance of the reward of human effort must not be based solely upon the result of human effort as embodied in houses, mills, factories, railways, canals, ships, machinery, for these structures are not indestructible. Even those that endure for centuries may fluctuate in value as they increase or decrease in their capacity for service to society, because of change in the currents of the law of supply and demand, or as they are honestly and capably or dishonestly and incapably managed. As it is for the results of human effort in all their varied forms that the aggregate of human effort is put forth, its reward should be the assurance of a given measure of effort as embodied in desired results.

A paper currency, therefore, should be based directly upon the assurance of the result of human effort to make its value good unqualifiedly and unconditionally; and that it may attain the utmost confidence, such assurance must be universally known to be sufficient and reliable. This can only be when a group of people, the members of which, perceiving a secure currency to be vital to their prosperity, combine in giving that assurance. Such a group of people cohering by the force of common need, constituting a state or nation, can give assurance of their combined effort through enactment of their administrative body known as the government. The instrument whereby that enactment can be made good is the power of taxation, which is the power of the government to take from its people a portion of their effort for the attainment of ends necessary to their common good. The acceptance of such a currency among a people will depend in natural course upon the degree of their coherence as evidenced by their confidence in the honesty and ability of their own gov-

ernment to make the currency good, and also upon the knowledge of the values represented by the different representatives of value constituting the currency. Its acceptance among other peoples will depend also upon the facility with which it can be exchanged for currency in general use in their countries.

That a paper representative of value, resting upon the power of taxation, may attain a high degree of confidence, is evidenced by the United States bonds themselves, which are eagerly sought throughout Europe and America; and the national bank notes, which rest upon the same basis as the bonds, are readily accepted throughout the entire country. But there is a respect wherein the provision for currency, if limited to the issue of bank notes secured by Government bonds deposited by the issuing source, has been seriously defective. In every country, and especially in one covering so extensive a territory and with such varied resources as the United States, the processes of production and distribution do not proceed with evenness and regularity week by week, month by month, or year by year. In the spring, great quantities of fruit are shipped North from the semitropical lands of the South; in the autumn, innumerable train loads and vast cargoes of grain come from the Western plains to the Atlantic seaboard; the great mills and factories in every line of industry are busier at one time of the year than another. Currency in greater abundance is therefore needed at the times of greater activity than during the periods of comparative dullness. If there be sufficient national bank notes for the times of activity, there is during the times of dullness a plethora which is an incentive to overtrading and speculation. If their issue is only sufficient for the ordinary needs of exchange, there is a scarcity at the times of greater demand, with the result that exchange is hindered, the processes of industry retarded; that is, the currency provided by our present national bank note system is not elastic, and the restrictions imposed by the Government have made its issue so little profitable that the banks are often loath to increase the supply, which at the present amounts to but about two hundred millions of dollars.

The paper currency of the United States issued directly by the Government is composed principally of United States notes, the "legal-tender" legacies of the war, to the extent of $346,000,000, which, like the bonds, are based directly upon the power of taxation; certificates issued directly against and redeemable in silver to the amount of $345,000,000; Treasury notes issued against silver, but redeemable in either gold or silver, to the extent of $137,000,000; and certificates issued directly against and redeemable exclusively in gold to the extent of $45,000,000. The lack of elasticity is an objection to each of these issues of currency, and that they are open to other objections recent discussion has made

evident. Gold, the standard of value in international exchange, has for many years exceeded silver in value in greater ratio than that deemed by the United States to exist between them. As it has been the declared intention of the Government to keep all the paper currencies issued by it of the same value as though they had been issued against gold, its currency must be exchanged for gold upon the request of the holders. But as the legal tenders, when accepted in exchange for gold by congressional enactment, must be immediately paid out again, to be again exchanged for gold if the holders so request, and so on without limit, the supply of gold in the Government's possession has been kept at so low an ebb that it has often been feared that it would not be able to maintain its intention of keeping all its issues of currency as good as gold. To avert this fear, the Government has increased its indebtedness by several issues of bonds which have been exchanged for gold, which the legal tenders have immediately again begun to drain. It is obvious that this and other evils of the immediate situation must be removed. But, without further reference to them, this article must return to the discussion of an ideal system of note issue.

The experience of the United States, as referred to in the preceding paragraph, makes important in that discussion the reply to the question—

Should the paper representatives of value which serve as currency be issued directly by the Government ?

The determination from time to time of the amount of currency necessary for a nation's exchanges at all places within the territory of that nation would require the services of a large number of intelligent men, thoroughly organized; and that the currency might expand and contract according to the nation's needs, a governmental mechanism would have to be provided that is difficult of conception, and its maintenance in efficiency would be more difficult. The losses occasioned by the errors of the officials would fall directly on the Government, and therefore entirely upon the whole people; and as the issue of currency in any event must be closely allied to the business of banking, if not always practically an incident thereof, the maintenance of a governmental organization for that purpose would impose a superfluous burden upon the people, as the banking organizations are capable of the same function.

As it is the banks that, by making loans and discounts and cashing checks, can the most readily get notes into circulation and can profit by so doing; as it is the banks that come directly into contact with the business pulse of entire communities, it is evidently proper that banks should be empowered to issue representatives of value for use as currency upon such resources as

would assure the value of such representatives of value, and under such checks and restrictions as would insure the expansion and contraction of issue in accordance with the law of supply and demand, not only in particular localities but throughout the nation. But as it is vital to the prosperity of the entire nation that its currency be incontestably and unquestionably secure, the guarantee of the whole people given through their Government should be the ultimate assurance of the security of their currency. The checks and restrictions upon its issue by banks should provide, therefore, that the liability for loss lie as far as possible with the banks, reducing to a minimum the responsibility, in any event, of the Government. To insure elasticity, these checks should be such as to necessitate the expansion and contraction of the currency in accordance with the law of supply and demand, by providing that, should there be insufficient currency, the banks would suffer loss, and that they also would suffer loss should there be an overabundance. The issue of currency by banks under governmental regulation and control should secure to the people the benefits that flow from competition reacting upon enterprise, and the benefits that come from the solidity of governmental backing. It should avoid the evils of overissue and speculative issue into which private enterprise is apt to be induced by greed and overcompetition, and the evils of that inertness which is characteristic of operations conducted entirely under bureaucratic control.

That such a system is not impossible of attainment, may be disclosed by an examination of different banking systems in force at different times and places, each of which has been characterized by one or more of the points of excellence which have just been specified.

Under the Scotch banking system, which has bravely stood the test of time, circulating notes are issued directly against the assurance of the forthcoming of human effort given by the drawers and indorsers of promissory notes. These promissory notes are paid with the results of the effort elicited by the circulating notes obtained in exchange for them. Although many of the old State banks are of unhappy memory, the Bank of Indiana and the banks of Louisiana were efficient in supplying currency for the commercial needs of their sections and are of honorable record.

An existing banking system of admirable performance is that of the Dominion of Canada. Under the Canadian banking act, adventurers and light-weight financiers are debarred from establishing banks by the fact that a charter is not issued for less than a capital of five hundred thousand dollars, of which at least two hundred and fifty thousand dollars must be paid up, and the character of the applicants is subjected to close scrutiny by the Minis-

ter of Finance. Notes are a first charge against all the assets of the issuing bank, and there is a penalty for excessive issue. The shareholders are liable for double the amount of their stock. There must be monthly returns to the Minister of Finance, and there is a rigid system of inspection. To insure the stability of the entire bank-note issue, each bank is required to keep on deposit with the Minister of Finance a sum equal to five per cent of its circulation, as a contribution to the Bank Circulation Redemption Fund, held by the Government to make good the notes of suspended banks. A most noteworthy and beneficent feature of the system is the practice of branch banking, the thirty-eight Canadian banks having four hundred and sixty offices. By their means the banking facilities of circulation, deposit, and discount are given not only to communities of considerable population, as in the United States, but even to hamlets remote from commercial centers. The competition of the different banks throughout their various branches, each striving for as large a proportion of the note circulation as possible, together with the governmental restrictions upon overissue, insure to the millions of people inhabiting the Dominion a supply of currency, that at all times sufficient for their needs, expands and contracts as the demand for it rises and falls. The principle of branch banking places the available funds of the entire Dominion at the disposal of the communities needing them at the times of need, whereas in the United States, because of the narrow sphere of operation of each bank, there is frequently an overabundance of currency at one point, while the healthy exchange of effort is retarded at other points because of a deficiency.

The "Baltimore plan" proposed in 1894 by the American Bankers' Association, and the bill introduced by the present national administration in Congress in December, 1894, were in their essential characteristics substantially similar to the Canadian banking law, and it was the opinion then expressed of most competent financiers, that the adoption of such an act would have relieved the country of the most crying evils of the present system, and have provided the foundation for a most wholesome currency hereafter. It is noteworthy that the provisions of the Canadian act were largely the outcome of the recommendation of the leading bankers of Canada called in conference by the Canadian Government, while financial authorities, among the highest in the United States, found members of both Houses of Congress deaf to their recommendations during the discussion of the administration measure, which was finally defeated by the votes of demagogues subserving selfish interests. It, however, goes without saying, that the province of true statesmanship is often not to persist in seeking the immediate attainment of an ideal when it is unquestionable that opposition makes that immediate attainment

impossible, but to better existing conditions to the extent that betterment may be possible.

The steps that followed the defeat of the administration bill are well known. There have been additional issues of bonds which may serve as the basis for additional bank-note circulation under present laws. A better system will doubtless be adopted in time, but enlightenment as to the ultimate basis of representatives of value, and their use in forwarding civilization by effecting the exchange of human effort, will need to spread in great waves to the minds of many people before there is the adoption of an ideal monetary system, and before such a system will diminish the need for money changers by effecting exchanges of effort without their aid.

And it should be perceived that the adoption of a monetary system consisting of paper representatives of value, based upon the result of human effort, will be an important step toward the determination of an absolute standard or measure of value. The attempts to invest gold or silver, or both, with the attributes of such a standard are the underlying causes of a current phase of the monetary problem that is uppermost in discussion. To the word "bimetallism" many different meanings have been attached. But, as even the most pronounced advocates of the gold standard do not oppose the use of silver for subsidiary currency, the question evidently has not now to do with the abolishment of silver as money; and as the most pronounced advocates of silver at present, in demanding even the unlimited coinage of that metal, insist that its value always bears a definite and fixed ratio to the value of gold, the question evidently has not now to do with the maintenance of a double standard of value, for if the ratio between the metals can be constant, there necessarily is but a single standard. That neither silver nor gold throughout the past has afforded an absolute standard of value is abundantly shown by the frequent fluctuations in the value of these metals, both as compared one with the other and either with other commodities.

The ratio between the value of silver and gold that was fairly level from the beginning of the expansion of mediæval commerce to the middle of the sixteenth century, was violently disturbed by the great yield of the silver mines of Potosi. The instability increased with the variations in the supply of silver as mines were opened in Mexico, and in the supply of gold as that metal was found in Brazil. The disturbance became feverish with the discovery of gold in California, and the oscillations in the ratio have since that time not ceased, having been affected by the output of silver from the Western States, and apprehension is now being felt as to the effect of the development of new gold fields in Colorado, Siberia, South America, and Africa.

During the Christian era the ratio between the values of the two metals has varied from eleven to one to thirty-two to one, which is about the commercial ratio to-day. The question at the root of the present bimetallic controversy, therefore, is:

Can a definite ratio be preserved between the values of silver and gold, notwithstanding that under the law of supply and demand the ratio rises and falls?

There are those who think that such a definite ratio can be fixed and maintained by legislative enactment, either national or international, but the possibility of the maintenance of a fixed ratio is negatived by the history of at least five centuries. This is nowhere shown more clearly than in the valuable History of Currency, by W. A. Shaw; the verdict is "clear, crushing, and final"—that is, the purchasing power of a pound of gold or a pound of silver in the markets of the world is never a matter of certainty for any extended period. This is not alone because of the fluctuation in the value of other commodities, but also because of the unequal fluctuations in the value of these commodities themselves. The results that naturally follow these fluctuations legislation is powerless to change. Since 1890 the United States has been learning this fact through bitter experience. As stated on a previous page, the nation has incurred an indebtedness that will approximate three hundred millions of dollars in the effort to maintain the ratio of 15·98 to one.

It was long claimed by radical advocates of silver, that if the mints were open to the unrestricted coinage of that metal, as they are to the unrestricted coinage of gold, coins of the two metals would circulate together, and a double standard be thereby established. But it is clear that the silver coins would inevitably be accepted at their bullion value only. The effort of the national administration to maintain the parity of the two metals, which has been strained even under the restricted use of silver, would be broken by the deluge that its unrestricted use would bring. The four hundred and twelve and a half grains of silver that were worth one dollar in gold a generation ago would be worth but fifty cents in gold to-day. If four hundred and twelve and a half grains of silver were still molded and stamped as one dollar, gold dollars would be worth twice as much as silver dollars: there would be two separate and distinct standards of value. If, notwithstanding this, it should be the edict of Congress that dollars of the two metals should circulate side by side, it is evident that gold dollars would be hoarded, sent out of the country or melted, for no one would pay a gold dollar for an article that could be purchased with a silver dollar worth but half as much. The currency of the country would fall to the silver basis, and, as the bul-

lion price of silver is subject to great and continual fluctuation, all values would be uncertain, commerce would be restricted, manufacturing retarded. And it is obvious that the objections to the too extensive use of silver apply also to the use of paper representatives of value based upon silver.

But it must be recognized that the taking of such a step, disastrous as its total consequences would be, would not be absolutely without warrant of justice. Because of improved appliances and improved methods of production and distribution, the prices of nearly all the great staple products—clothing, shoes, furniture, grain, nails, tools, watches, drugs, glass, carpets—have in the last generation fallen in about the same degree that the price of silver has fallen. Therefore a silver dollar of four hundred and twelve and a half grains, taken at its bullion value to-day, will now buy about as much of the most needed results of human effort as a silver dollar of four hundred and twelve and a half grains thirty-five years ago, taken at its bullion value then, would buy of the most needed results of human effort at that time. Therefore a debt of one hundred dollars incurred thirty-five years ago, if paid to-day in gold, would inure to the creditor double the amount of benefit that the borrower obtained at the time the debt was incurred. Apply this reasoning to the indebtedness of the United States. It is claimed that, notwithstanding the great reduction in this debt since the war, the decrease in the prices of staple commodities, as measured by gold, has been so great that the amount of gold necessary to pay the present indebtedness would purchase at this time as much of the staple commodities as gold to the total of the indebtedness at the close of the war would have purchased at that time. That is, although the indebtedness of the Government, as expressed in gold dollars, has been vastly reduced, that indebtedness, as expressed by universally desired results of human effort, has not been reduced at all. In this connection it is significant that the depreciation in the price of silver has not led the people of Mexico to adopt other than the silver standard. Indeed, the depreciation has scarcely been noticed by them, largely because of the greater depreciation in the value of other commodities.

But as there are two sides to every question, so also are there two sides to every phase of every question. Wages, salaries, and incomes of all sorts, on the average, are far higher to-day than they were a generation ago. In many a pursuit it is easier for a man in a given time to earn two hundred dollars in gold to-day than it would have been for a man in the same pursuit to have earned one hundred dollars in gold then. So that the payment of a debt of one hundred dollars incurred then, in its gold equivalent now, would work no injustice to him. But this is not the

case in all pursuits. And does the application hold good with the United States bonds, whose holders in many cases have acquired them by inheritance and have throughout their lives made no contribution to that totality of effort from which is poured into their purses an annual interest that constantly increases in purchasing power? And the original holders of these bonds may have procured them by means of the revenue obtained from land that has appreciated in value through no possible effort or foresight of theirs. Do not all these considerations point to the fact that a standard of value which may measure justice to all and injustice to none must be based directly upon the results of human effort? It is not for an instant to be intimated that existing obligations shall be repudiated, nor can it be conceived that such an ideal standard will be attained save through slow and painful development. But the theoretical demonstration of such an ideal may even at this time not be beyond the bounds of possibility. And there may be all the more need for such demonstration because of the increase, both present and prospective, in the production of gold, which may at some future time cause the fluctuations in the value of that commodity to be no less than they have been in the value of silver.

But even the adoption of an ideal monetary system would not entirely deprive the precious metals of a positive monetary function. Until one such system were adopted by all of civilization, gold would be needed in international exchange; and for various reasons, perhaps, whether the basis for circulating notes were the assurance of the result of human effort as given in promissory notes, or whether it were stocks, bonds, or other securities depending for their value upon the result of human effort, it might now and then happen that the holders of the notes might want to make an immediate test of their value. The issuing source to preserve confidence in the notes emitted by it must be able to satisfy this test. As the medium of exchange that antedated notes and that has not been entirely superseded by the issue of notes is coin; as coin has a definite intrinsic value, which notes have not; as coin is durable, portable, and readily exchangeable—it follows that a natural and practical immediate test of a note's security is the readiness with which it may be exchanged for coin. To this end, when authority to issue notes has been given, it has usually been required that specie in a certain minimum ratio to the value of the note circulation be held by the issuing source for the redemption of notes presented for that purpose. The facility for the exchange of notes for coin may be not only a test of their security, but, as in the Dominion of Canada, a means whereby through the competition of various banks the note circulation may be contracted as need for it is lessened, each of the Canadian

banks being required to redeem daily such of its notes as are presented for that purpose.

And this last reference to the Canadian banking system gives rise again to the thought that perhaps, if there could yet be adopted in the United States a banking system modeled upon something of the same plan as that of Canada, it would give the nation more relief than could any other step that is now at all practicable in connection with monetary issue. Such a system would provide within safe limits the abundance of currency that the farmer and the laborer struggling for a livelihood in the West and Southwest are led by fallacious reasoning to believe can only be obtained by the free coinage of silver.

WHY PROGRESS IS BY LEAPS.

By GEORGE ILES.

As master of electricity man is crowned the king of Nature. A brief glance at what electricity has done and promises to do may have interest in itself; it may have yet more in disclosing the law by which art and science march onward with ever-hastened pace, how it comes about that the history of modern progress is little else than a story of revolution. We shall see that the subjugation of electricity means for thought and work not an addition merely, but a multiplier. It marries the resources of the mechanic, the engineer, the chemist, the artist, with issue attested by all its own fertility, while it annexes province after province unimagined before its advent. Because the latest upward stride in knowledge and faculty has fallen to the lot of the electrician, he has broadened the scientific horizon vastly more than any earlier explorer; beyond any predecessor he has found more in the field wherewith to prove the fecundity that infallibly stamps every supremely great agent of discovery. As we trace a few of the unending interlacements of electrical science and art with other sciences and arts, we shall be reminded of a series of permutations where the newest of the factors, because newest, multiplies all the factors that went before by an unexampled leap.* We shall find reason to believe that this is not merely probable, but really is as a tendency true, and not alone of the

* Permutations of two elements, 1 and 2, are (1×2) two: 1, 2; 2, 1; or *a*, *b*; *b*, *a*. Of three elements the permutations are $(1 \times 2 \times 3)$ six: 1, 2, 3; 1, 3, 2; 2, 1, 3; 2, 3, 1; 3, 1, 2; 3, 2, 1; or *a*, *b*, *c*; *a*, *c*, *b*; *b*, *a*, *c*; *b*, *c*, *a*; *c*, *a*, *b*; *c*, *b*, *a*. Of four elements the permutations are $(1 \times 2 \times 3 \times 4)$ twenty-four; of five elements, one hundred and twenty, and so on. A new element or permutator multiplies by an increasing figure all the permutations it finds.

gains which follow in the train of conquered electricity, but also with regard to every other signal victory which has brought man to his present pinnacle of power and insight. If in former advances this permutative principle has been undetected, it stands forth in clearest relief in that latest and therefore utmost stride of skill and interpretation ushered in by Franklin, Volta, and Faraday. And we shall presently note that this permutative tendency offers a key to some puzzling chapters in the biography of the creatures which man has far outstripped in the race of life, and may also shed a needed ray on the story of the planet where they and he have together struggled and vanquished or succumbed. If all this may be maintained, a permutative tendency can perhaps be suggested with respect to evolution in general as colorably as with regard to development in particular realms. Is this a large claim? To the evidence, then:

By way of preface, let us for a moment consider the achievement most worthy to be compared with the conquest of electricity, and, indeed, its necessary precursor.

When man first kindled fire, he rose to a new primacy among created beings. Long before that fateful day he must have noticed how the blaze of a tree riven by lightning could bring roots and herbs to refreshing palatability, or, as a far volcano welled forth its lava, how welcome the radiance in wintry air. What, he may have thought, if I can summon fire at my bidding instead of waiting upon heaven to let it fall or earth to belch it forth? How the wish came to fulfillment has been the subject of many an ingenious guess. The likeliest of them imagines that in striking a bit of quartz against a flint to point an arrow, a spark fell on dry tinder, and that what at first was accident was soon repeated by design. No piecemeal acquisition this, like learning to hit a mark with stone or bolt. The man barely able to light a fire was enormously advantaged as compared with his fellow, however dexterous, who just fell short of this skill. At once the fire-maker took a bound forward that decisively withdrew him from his next of kin. It was as if the globe had expanded itself beneath his tread; for now, no longer chained by the sunbeam, all the frozen north was added to his hunting ground. The burning brand cleared his path through the forest or shaped from a tree trunk his rude canoe. It lifted the dreary pall of night. His hearth, heaped with boughs, cheered with light as well as warmth, and became the family rallying place and altar. Baneful roots buried in its embers lost their poison and furnished a toothsome meal, while food of many kinds when roasted or seethed was improved in flavor and could be longer stored to abridge the seesaw between plenty and want. As the cook daubed clay on her roasting tray of twigs that it might the better withstand flame, she

soon learned that clay by itself was a capital material for oven, pot, or kettle, and Sèvres and Worcester, with all their varied art, here took their rise. As primitive fisherman and hunter, man employed fire to lure his prey, to affright the beasts to which he himself was prey, or to yield protecting smoke against insect pests scarcely less to be dreaded. In later ages as mariner he erected on storm-beaten coasts beacons whose carefully tended blaze gave warning or comfort to drifting voyagers, the flickering ray foretelling the sunlike beam of Sandy Hook or Skerryvore. As warrior he crowned the hills with similar flares to voice alarm to scattered allies, prefiguring every modern telegraph. Again, as warrior, having profited by the hardness fire conferred upon his wooden spear, he was to receive gifts yet greater. Where, as on the shores of Lake Superior, native copper almost pure lay upon the ground, it was laboriously pounded into the primitive knife or hammer. With fire his servant, the savage was independent of such rare finds. Wherever he came upon an earthy mass, glittering with however small a fraction of metal, he had but to bring the ore to his hearth to free copper or iron from its bondage. There and then the art of the founder began to take the place of the drudgery of the smith—a supersedure characteristic enough and one of an uncounted series where good has had to make way for better, where the worker and the fighter himself has been overcome by stronger thews and keener wits. No triumph of miner or chemist, of engineer on land or sea, that does not date from the memorable hour when a savage just a little cleverer than his fellows kindled for himself a blaze. Plainly, then, fire came among the resources of man as a permutator of exalted power. It gave an impulse to food-getting, to tool and weapon making, to building, to migration, to every art that cheered and adorned the home. It was an influence as pregnant as any that has made man human and brought the empire of Nature to his feet.

Through the course of all the ages since, almost down to our own day, flame had beside her a twin force all unrecognized. Elusive as a wood nymph she glinted as lightning, or as the aurora streamed fitfully across the sky. Anon she condescended to the amber of the sea beach, which under gentle friction drew to itself fragments of fallen leaves, of withered straw. In yet other guise she defied the downward tendency of unsupported masses, and, as the legend tells us, sorely puzzled a shepherd in bidding his crook cling fast to the ceiling of a cave roofed, as we would say now, with magnetic ore. At a later day the magnet became something more than an empty marvel, and as the compass assumed the office of guiding sun and star when these were hidden. Little wonder that so various a masquerade was long

impenetrable, that Franklin less than five generations ago should detect that lightning and electricity are one, and that only in our day at the hands of Hertz has it been demonstrated that the electric pulse differs only from the wave of heat or light in being longer. This discovery of Hertz was long ago foreshadowed in the observation that heat can have electric origin. One of the first fruits of electrical study was the finding that some metals transmit electricity better than others, and that the efficacy of a conductor depends in part on its size. When a conducting wire was reduced to extreme tenuity, the resistance to the current's passage, with striking resemblance to common friction, expressed itself as vivid heat. The miner and the gunner at once saw their opportunity to use electricity to touch off their fuses and to explode at the same instant, with an effect before impossible, a round of separate charges.

Copying the methods of the miner, the mechanic and the chemist very often find electric heat the most advantageous they can employ. When the broken blade of a propeller is to be repaired, the electric welder can be taken to its work instead of the work having to go to a stationary welder. When electric heat is carried into a crucible through almost impenetrable walls of gypsum, it enters the very heart of its task without the offense and waste of flame. Thus to-day is flame face to face with a supplanter in the shape of its long undetected twin. Until this generation flame alone was the source not only of heat, but of the beam of candle, lamp, and gas jet. To-day myriads of electric bulbs are aglow without flame—indeed, just because combustion is rendered impossible by the rigid exclusion of air. As these incandescent lamps were long ago prophesied in the miner's electric fuse, so also has the first simple process of the electroplater led up to an art incomparably more important. To-day not surfaces merely, but large masses, chiefly of statuary, are built in cool tanks by electricity. Let the current become cheaper still, and the founder may find the remainder of his business transferred to this formidable rival, the warping heats of sand molds banished, the scorching temperature of crucible and ladle a reminiscence. The same fate may be in store for the smelting furnace. Already vast quantities of copper are refined electrolytically, and an auspicious beginning has been made in using electricity for the whole process of parting metal from ore. Thus methods which commenced in dismissing flame end boldly by eliminating heat itself. This usurping electricity, it may be said, usually finds its source, after all, in fire under a steam boiler. True, but mark the harnessing of Niagara, of the Lachine Rapids near Montreal, of a thousand streams elsewhere. In the years of the near future motive power of Nature's giving is to be wasted less and less, and per-

force will more and more exclude heat from the chain of transformations which issue in the locomotive's flight, in the whirl of factory and mill; and thus in some degree is allayed the fear, never well grounded, that when the coal fields of the world are spent, civilization must collapse. As the electrician hears this foreboding, he recalls how much fuel is wasted in converting heat into electricity. He looks beyond either turbine or shaft turned by wind or tide, and, remembering that the zinc dissolved in his battery yields at his will its full content of energy, either as heat or electricity, he asks, Why may not coal and forest tree, which are but other kinds of fuel, be made to do the same?

In another field let us observe electricity as a factor of fruitfulness quite as singular. It was at first the chemist who emancipated electricity for new and myriad uses. His successor to-day is the engineer, who wins his spurs by bringing his generator to practical perfection, by improving his steam and gas engines to double their efficiency of thirty years ago. If to the engineer and mechanic the electric art owes much, magnificently has the debt been repaid. As we discover in replacing at our street door an old-fashioned moving bell pull by an electric wire armed with a push button, electricity transmits motion without movement of its conductor as a mass. Availing himself of this golden property, the machinist removes from his shop a labyrinth of wheels and belts and puts in their stead a few wires at rest, each in charge of the motor actuating a machine. Manifold gains result. The power needed to whirl these wheels and belts is saved, and when but one or two machines of a large number are to be set in motion the economy rises to a high figure, while the workshop is lighter, cleaner, more wholesome in every way. Since electricity is of all phases of energy the easiest to preserve from losses resembling leakage or friction, the current can not only be distributed throughout the largest workshop with convenience and economy, it can be sent to the shop from an engine or a water wheel many miles away, as in connecting motors at Buffalo to dynamos at Niagara, twenty-seven miles distant. With the transmission of electricity for distances vastly exceeding twenty-seven miles we have long been familiar in the telegraph. It is by improving the coverings which prevent the current escaping from its wire, by taking advantage of the fact that a wire can almost as well carry a current of high tension as of low, and, above all, by increasing the quantity of the current so as to make the enterprise worth while, that the telegraphy of power has followed upon the telegraphy of mere signals.

In the telegraph at work over long distances a remarkable peculiarity of electricity displays itself. In days of yore, when letters were intrusted to a chain of messengers, each of whom bore

the pouch for a stage of its journey, a carrier might come to the end of his trip utterly fagged out; but if he had barely the strength to pass his burden to the next man it was enough. Much the same is the system of relays when a telegram takes its way from New York to Tacoma. First it goes to Buffalo, where the current, faint after its run of four hundred and forty miles, touches off a second powerful current born in Buffalo. This in its turn bears the dispatch to Chicago. There a third current is impressed into service, and so on, until at the end of a succession of transfers the words are clicked out in Tacoma. This whole process is committed to self-acting repeaters that do their work in the fraction of a second. It is in pulling triggers in such fashion as this, in liberating forces indefinitely greater than the initial impulse, that electricity brings to muscles of brass and steel something very like a nervous system, so that the merest touch directs the course of a steamship through the tempest-tossed Atlantic. Engineer, workman, and artist can thus reserve their strength for tasks more profitable than muscular dead lift and find their sweep of initiation and control broadened to the utmost bound. In the field of war, for instance, a torpedo can be launched, propelled, steered, and exploded by a telegraph key a mile or two away; the constructor may, indeed, confidently give all his orders in advance and build a torpedo which will fulfill a fate of both murder and suicide predestined in its cams and magnets. Or a camera, under the control of an operator at the safe end of a wire, is sent soaring in a balloon car above an enemy's camp, effectively playing the spy.

Another apparatus electric and photographic, happily less uncommon, is employed for observatory records which, as near Arequipa, in Peru, without supervision keeps itself busy for a fortnight together. Still more remarkable is Mr. Muybridge's round of cameras, timed as only electricity can time them, which seize practically instantaneous views of figures in rapid motion, as horses trotting. In Mr. Edison's kinetoscope photographs made at each forty-sixth of a second follow one another so quickly under an eyepiece as to fuse with the effect of life and action. Pictures of birds thus caught on the wing may prove seed corn for harvests to be reaped by the experimenter in mechanical flight—an achievement which, strange to say, attracts the interest of military rather than business men. In the service of war and peace one would suppose the ordinary telegraph to be speedy enough. Not so, thinks the inventor. In the latest process a dispatch wings its way from New York to Chicago at the rate of one thousand words a minute, to Philadelphia thrice as fast. The telegram is taken first to a machine which symbolizes each letter as perforations on a strip of paper; then the strip is run between

metallic springs of exquisite delicacy. At each perforation the springs touch and the current takes its way through the wire. At the receiving station the delay involved in the arousal and action of electro-magnets is abolished. The current instant by instant writes its message on a moving ribbon of paper sensitized so as to change color under an electric flow. This instance is typical of what ingenuity can do when electricity is added to its armory. A task is divided between an operator and an automatic machine in such wise that intelligence is allotted only that part for which intelligence is required, while for the remaining part the utmost speed of electrical and chemical action is invoked—a pace which in this particular case sixtyfold outstrips the most dexterous manipulation.

Another means by which inventors have expedited telegraphy has been by transmitting several messages simultaneously over a single wire. Of these multiplex systems certain are synchronous in principle and seem to have suggested to Prof. Elisha Gray his telautograph, an instrument that imitates exactly the motion of a pencil, in say Boston, by the motion of another, in say Baltimore, reproducing with equal facility either handwriting or outline drawing. To understand the principle involved, let us glance at an everyday application of electricity in keeping scores of clock pendulums, no matter how far apart, in perfect step. If two pendulums at right angles to each other are attached to a moving pencil their motions may be communicated to a distance by two currents which actuate two pendulums in control of a second and copying pencil. The electric clock at which we have just been looking can, if we please, be sealed in a glazed box, secure from dust and dampness. Here opens a fresh path to the inventor who wishes to avoid the resistance or leakage entailed when a rod moves through a slot or a stuffing box. It is often of cardinal importance that a bit of metal at rest should throb with a pulse strong enough to do severe drudgery or tell a tale which otherwise would go untold. If an engineer wishes to know how much heat wastes itself through the walls of a steam cylinder, his question is answered through a motionless wire attached to a delicate metallic thermometer buried in the cylinder's mass. In experimenting with new alloys the same method informs the chemist of changes of temperature at the core of his crucible, changes often abrupt and transient and at times denoting qualities he seeks to detain or reproduce. In a very different domain of exploration the engineer uses the telephone to expose perilous defects in metal beams.

As we prove when we unhook a telephone, or lift an incandescent lamp, electricity readily traverses a flexible wire: this unbars a fresh resource to invention. To-day rock drills, coal cut-

ters, and deck planers are designed in forms which combine motor and tool; so much is thereby gained in adaptability that a remodeling is in progress of much light machinery in its first estate rigidly limited in play by shafts, belts, or gearing. Dentistry and other arts of refined manipulation are indebted for novel facilities to the flexible mechanical shaft—a tightly wound coil of steel wire. This device is in turn being shown to the door by the new partnership between an electric thread and a tool. And the wire, however slender, which binds a reservoir of power to its work, can on occasion be discarded, as in the rolling contact of the electric trolley wheel. And even contact can be dispensed with if strict economy is not imperative. We are familiar with the annoyance, due to induction, of being obliged in a telephone circuit to overhear other subscribers, whose wires are often far distant from our own. A hint in this for the engineer at the head of the British telegraphs, Mr. Preece. Utilizing induction, he has established a telegraph between Oban and Auchnacraig, divided by six miles of sea, using wires strung along the opposite shores.

Electricity, light, heat, and chemical action are all in essence motion; electricity is the most desirable of them all, because it can most readily and fully become the source or issue of any other. The pre-eminent sensitiveness of electrical apparatus makes it a surpassing means of measuring minute portions of space or time, of light, heat, chemical activity, or mechanical motion. Hence a brood of telltales of widely contrasted purpose. Selenium, a metalloid of the same lineage as sulphur, and betraying its descent by a striking family resemblance, has the curious property of transmitting electricity more freely in light than in darkness; a stick of selenium, therefore, is the pivot of a device to give warning when extinction befalls a lamp charged with important duty. In thermometers a circuit broken or completed acts as a fire signal, or, on shipboard, heralds the approach of an iceberg. Electric fingers sound a gong when the water recedes below the safety level in a steam boiler, or report an attempted breach of bolt or bar by the burglar's jimmy. Each of these warnings can be registered at a distance, so that in case of neglect by an attendant there can be no disputing the fact. Now, if an electric alarm can summon a servant to duty, why may not the inventor go further, and so add to his device that it shall of its own motion do what needs to be done? Accordingly, we find furnaces fitted up with electrical control, so that the draft is opened or fuel added when the temperature falls too low, or the reverse, when the flame is too fierce; when the fuel is gas this stoking leaves nothing to be desired. New mechanism of this kind is constantly being contrived. The inventor who began by conferring electric nerves on muscles of brass and iron has,

thanks to electricity, gone the length of combining his wires and magnets into something very like a conscious and responsive brain: his intelligence culminates in duplicating itself.

Prodigal as electricity is of gifts to the mechanic and engineer, it as generously multiplies the resources of their friend and partner, the chemist. Electricity, we must not forget, was presented to the world as a stream of tolerably even flow, by a process of chemical undoing, in Volta's crown of cups. If chemical taking apart can yield a current, a current can in turn be used to build, as every piece of plating proves. Yet to construct a battery in which both processes shall alternate, without undue weight or waste of material, is a task as yet not satisfactorily accomplished, despite constant and ingenious attack. A thoroughly good and simple storage battery would mean nearly as much for electric art as the dynamo. From a dynamo it would receive currents derived from wind or water powers, or from engines temporarily laden below their capacity, and use these currents to restore a metal from its solution by a process exactly that of electroplating. Then, on demand, it would yield electricity once more by surrendering this metal to solution, as a common voltaic battery does. If the chemist has thus far been somewhat baffled by the problems of the storage battery, he has had better fortune in other fields of endeavor. Electricity joined to heat hands him a two-edged sword of irresistible cleaving power. Compounds, such as those of chromium, of peculiar refractoriness, are readily parted in the electric furnace of Moissan, and elements once extremely rare are now marketed in quantity at prices steadily falling. A generation ago aluminum was so scarce and dear that it was formed into jewelry; to-day the metal has been so cheapened by electricity that it finds a ready sale as kitchen ware. Minute diamonds and rubies of electric manufacture are now competing with the product of the mine, and materials used on a gigantic scale in the arts—caustic soda, bleaching powder, and the like—are produced at less cost than ever by electrical agency. The chemist, when he chooses, can beat his electrical sword into a trowel, and build compounds which seem prophetic of the day when the slow elaborations of the farm and orchard shall make way for the artificial synthesis of sugars, oils, and starch.

Greater than all the wealth created by electricity in workshop or laboratory are its aids to pure research. The chief physical generalization of our time, the persistence of force, came into view only when electricity was recognized as a phase of energy, only when electrical means of measurement had become trustworthy. It is because men of absolutely disinterested spirit, like Faraday and Henry, devoted themselves to ascertaining the laws of electricity that we have to-day the telegraph, the telephone, and

the electric furnace. "Before there can be applied science there must be science to apply," and it is in enabling the investigator to know Nature under a fresh aspect that electricity rises to its highest office. As a case in point, take the bolometer of Prof. S. P. Langley: its delicate wire, sensitive to one millionth of a degree centigrade, is moved by minute steps through the invisible areas of the solar spectrum; each indication of temperature, automatically photographed, comes out in a series of dark and bright lines. This process, repeated with each chemical element, promises that one day the physicist will have before him a full or tolerably complete map of every distinctive spectrum. He can then ask, Given such and such vibrations, how is the body constituted that sent them forth ?—much as a musician might try to reason from the tone and timbre of a note to the structure of the instrument which uttered the note. In further uses of photography the physicist, by means of instantaneous contacts, is beginning to find out what goes on in the critical moments when chemical collisions in the voltaic cell are gliding into electric waves—an inquiry which bears on the prime question of electric art, namely, how the chemical energy contained in coal can be transformed into a current without the enormous levies imposed by the steam engine. Hertz, in the purely scientific excursion by which he generated electric waves intermediate in length between those of sound and light, came upon a discovery of profound interest—that, given its appropriate ray, every substance whatever offers it a free and open path. It remained for Prof. Röntgen to complete the proof that certain of these rays, while refusing obedience to the laws of light, can, nevertheless, exert photographic power. His apparatus combines in the happiest way the utmost resources of both the electrician and the photographer; at a vital point it employs the singular capacity for fluorescence whereby the compounds of barium and other substances can convert to visibility an otherwise invisible image. Apart from such a triumph as this, rich in possibilities for art and science, the common routine of ascertaining electrical constants has high value in research; to know the conductivity, polarizability, and other electrical properties of matter is to peer at its architecture through new windows; to detect many of the links which bind atom to atom, molecule to molecule. A new orchestration of inquiry is possible through the instruments created by the electrician, through the advances in method which these instruments suggest. Hence to-day a surround is in progress which may early in the twentieth century make atom and molecule as obedient to the chemist as brick and stone are to the builder now.

But, however much new knowledge may do with electricity, some of its best work is already done. It is not likely in the fu-

ture to perform a greater feat than placing all mankind within earshot of each other. Were electricity unmastered, there could be no democratic government of the United States. To-day the drama of national affairs is more directly in the view of every American citizen than a century ago the public business of Delaware could be to the men of that little State. Railroads, with all they mean for civilization, could not have been born without the telegraph; and railroads and telegraphs are the sinews and nerves of national life, the prime agencies in welding together the diverse and widely separated States and Territories of the Union. A Boston merchant builds a cotton mill in Georgia; an Illinois manufacturer establishes an agency in Seattle; the telegraph, which informs them day by day how their investments prosper, tells idle men where they can find work, where work can seek idle men. Chicago is laid in ashes, Charleston topples in earthquake, Johnstown is whelmed in flood, and instantly a continent rises to their relief. And benefits denied to charity issue in the strictly commercial services of the telegraph. Its click has exorcised the fiend of famine from every quarter of the civilized globe; for, with its finger on the throttle-valves of locomotive and steamship, no longer does food rot here when thousands lack bread there; the markets of the world are merged, and that one great market reaches every man's door.

In a less conspicuous way electricity works equal good. Its motor, freeing us from the horse's deliberate pace, is spreading out our towns and cities into their adjoining country; field and garden compete with narrow streets; the sunny cottage is in rivalry with the odious tenement house. Electric lines, at first suburban, are now fast linking town to town and city to city, while as auxiliaries to steam railroads they place sparsely settled districts in the arterial current of the world. Great as are the blessings which electricity brings to country folk, it stands ready to bestow yet more in the hives of population. Until a few decades ago the water supply of cities was drawn in part from wells here and there, from lines of piping laid in favored areas, and always insufficient. To-day a supply such as that of New York is abundant and cheap because it enters every house. Let a single electrical service enjoy a like privilege, and it can offer a current which is heat, light, chemical energy, or motive power at a wage lower than that of any other servant. Unwittingly, then, the electrical engineer is a political reformer of high degree. All that he asks is that this municipal electricity shall be under control at once competent and honest. Let us hope that his plea, joined to others as weighty, may quicken the spirit of civic righteousness so that some of the richest fruits ever borne in the garden of art and science may not be proffered in vain.

This rapid survey of what electricity has done and yet may do has shown it the creator of a thousand material resources: the corner stone of physical generalization; a stimulus to the moral sense, by making what otherwise were an empty wish rise to sympathy fulfilled; while, in more closely binding up the good of the bee with the welfare of the hive, it is an educator and confirmer of every social bond. Are we not, then, justified in holding electricity to be a multiplier of faculty and insight, a means of dignifying mind and soul, unexampled since man first kindled fire and rejoiced?

And the advances due to electricity have significance still unexhausted. It was in 1800, on the threshold of the nineteenth century, that Volta devised the first battery—the crown of cups. In less than a hundred years the force then liberated has vitally interwoven itself with every art and science, with fruitage not to be imagined even by men of the stature of Watt, Lavoisier, or Humboldt. Compare this rapidity of conquest with the slow adaptation, through age after age, of fire to cooking, smelting, tempering. Yet it was partly because the use of fire had drawn out man's intelligence that he was ready so quickly to seize upon electricity and subdue it. The principle of permutation, illustrated in both victories, interprets not only the vast expansion of human empire won by a new weapon of prime power, it explains also why these accessions are brought under rule with ever-accelerated pace. Every new talent but clears the way for the talents newer still which are born from it.

And a fresh mode of mastery entails other consequences well worthy of remark. Suppose two contending armies face each other, fairly matched, except that one has the telegraph and the other has not. Which will win? In less striking fashion, but still decisively, must every factor of prime rank as it made its appearance have told in the battles of early man. Let us turn from discovery and invention to some consideration of the primitive discoverer and inventor, and try to recall the epoch when his inarticulate cries were becoming the rudiments of speech. Let us imagine him a hunter returning to his fellows from a solitary expedition. He tells that he saw a deer quench its thirst at a brookside, but found the animal too fleet for his arrow; how he heard in the distance a bear's fierce growl, and fortunately came upon a cave where he took refuge till the brute had passed. Such a faculty of communication as this, even in its beginnings, would give a tribe enjoying it an incalculable advantage over its unspeaking kin. Speech makes the distant as if present in space, makes the past as if present in time; it is the first and most signal step, therefore, by which man conquers both space and time. No elephant or dog, however intelligent, has means to tell

what he saw here an hour ago, or what is to be found there beyond the range of the eye. Because in early times speech thus placed the experience of one man at the service of other men, the possessors of this matchless power could, if they chose, exert deadly rivalry against their mute next of kin, and either annihilate them, or banish them to sterile wilds, or degrade them to servitude. What is probable here is probable in other fields of struggle, and we have a hint as to why connecting links in the plexus of organic life are either very rare or wholly lacking. The introduction of a radically new weapon, or tool, would so redouble the strength of the creature able to grasp and wield it that its war on competitors would end so soon as to leave scarcely a relic on the field.

Speech led to another great achievement when it called to its aid the carved or painted symbol, the word-picture, and at last the alphabet. Then the recorder, the priest, the teacher, was no longer a mere speaker who had to be present when he told his story. Ages after his death, his annals, prophecies, parables, remained to be read, to echo his voice—and this perhaps on shores many leagues remote from the penman's home or grave. Knowledge could now be accumulated as never before, for every man could begin where the experience of his predecessors had left off. The culmination of this mighty art issues to-day in two wonderful instruments—the phonograph, which bids the spoken word record and repeat itself with all its characteristic tones; the camera, which instantly limns all the eye can see and more, which prints much that the tongue and the pen must leave unsaid. In a masterly discussion of the origin of languages and the antiquity of speaking man, Mr. Horatio Hale concludes that the acquirement of speech dates back but eight to ten thousand years. He credits speech and writing with the sudden and wonderful flowering of human genius which developed in Egypt, Mesopotamia, Phœnicia, Northern India, and China a high and varied civilization, whose memorials, in their works of art and literature, astonish us at this day, and in some respects defy imitation.*

To paint and to write implies a free and supple hand; gesture, upon which philologists are substantially agreed that primitive speech largely depended, requires the like freedom of hand and arm. Hence, before man could paint, or write, or even gesticulate, it was necessary that he should be erect. Man's assumption of the upright attitude marks one of the supreme stages of his progress. What have since become arms and hands, relieved from tasks of locomotion, were able to come into contact with

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* Proceedings of the American Association for the Advancement of Science, Buffalo, 1886, p. 315.

things and know them more fully and exactly than ever before. The brain, informed and stimulated by its new harvest of impressions, imagined fresh feats of skill and directed them. The rude stone, lifted from the ground and used as a hammer, was gradually shaped as an axe, a scraper, a chisel, an arrowhead. There lay the germ of the ingenuity which blossoms to-day in the locomotive and steamship, in the observatory camera which multiplies the known universe a thousand times, which in the telephone catches the echo of storms sweeping the solar disk. As with the faculty of speech, so doubtless also when the hand began to handle and to tell the brain what it could feel and do. A gain so pregnant as dexterity, even in its feeble inception, would come as an irresistible wedge between the fighters and the workers who had it and their fellows who missed it by however little.

The permutative tendency which we are tracing has dug other gulfs than those which part man and anthropoid. Let us glance for a moment at creatures far beneath mankind in the scale of being. Birds are clearly derived from reptiles, but how far apart to-day are the bird and the reptile! It was the power of flight, with all that it involved in transforming every organ of the body, in revolutionizing habit, that stood at the parting of the ways. Even in its beginnings this power would promote escape from enemies, the procuring food in places otherwise inaccessible. In the process of natural selection here would be the faculty valuable beyond any other, and therefore first seized in its favoring variations. Flight beyond any other capacity would thus be developed and increased as one generation succeeded another, until at last the flier could disregard its unwinged enemies, seek food on steepest crag or farthest islet, and there lay its eggs and nurse its brood with none to make it afraid. As far as the fossil record has been pieced together, it amply warrants this view of the early history of the avian race.

Take passage now to a widely different realm and note the permutative effect wrought when insects supplant the winds at the business of fertilizing flowers. Nectar secreted near the pollen of a plant attracts flies and moths brushed by this pollen; they sail away to other flowers and tie a marriage knot with an effectiveness impossible to the aimless air. The consequence is that simply through such woolliness of vesture as enables them to catch dust on their clothes, insects of narrowest intelligence are unknowingly the painters, sculptors, and perfumers of unnumbered varieties of blossoms. And indefinitely prior to either flower or reptile was the day when the earth, a fiery cloud, had come to the critical point, in its gradual loss of heat, where atom stood almost within the attractive range of atom, when the latent combinability of matter we call chemical was ready to be born. Was not the

releasing touch of cold a permutator of highest degree? It made every other possible, it forged the first link in the chain of forces, vital, mental, moral, in the life of earth and man.

What is here indicated in outline was suggested by the writer in the Popular Science Monthly for June, 1876. He has since gathered from men of mark in diverse walks of science data from which inferences such as those here set forth may be deduced in ample detail. These data he expects in due time to offer to the public, together with consideration of the facts which mask or qualify the permutative principle in evolution—a principle which accounts for the leaps of progress, human and general, for the accelerations of that progress, and for there being chapters missing in its story.

POSTHYPNOTIC AND CRIMINAL SUGGESTION.

By Prof. WILLIAM ROMAINE NEWBOLD.

IN my two preceding articles (March and April numbers) I have discussed what may be termed categorical suggestions and other closely related topics. I shall now take up certain other forms of suggestion.

From the conception of suggestibility it follows that any mental state, however initiated, tends to produce certain results. The most familiar method of initiation is through the instrumentality of language, but there are other methods. What is known as waxlike catalepsy, for example (*flexibilitas cerea*), is merely a form of suggestibility to motor impressions. When I take the arm of a cataleptic patient and bend it into a given position it remains fixed where I put it. In bending it I produce certain sensations, approximately those of a movement; among the possible results of such sensations is the production of the movement in question, and in the patient's disordinated condition this is the only apparent and perhaps the only actual result. It is also true that a pseudo-catalepsy may be found in less complete forms of disordination, in which the movement which I impress upon the arm is felt by the drowsy upper consciousness and accepted as indicative of a command. I saw some years ago a very curious illustration of an analogous motor suggestion in the case of a man who was subject to hystero-epileptic convulsions. Dr. B—— had hypnotized him standing; he then fell backward, and we allowed him to recline with his heels on the floor and his back flat upon the bed. This brought him into a very uncomfortable position, in which his head was bent backward toward his heels. He at once began to show signs of a convulsion, and, in spite of our imperative suggestions to keep quiet, grew worse every second. Then it oc-

curred to me that the attitude in which he was lying was one of the stages through which the patient regularly passes in the course of the hystero-epileptic convulsion—it is known as the opisthotonic position—and that the convulsion might be due to the tactile-motor suggestion given by the feeling of the attitude. As soon as we put him in a sitting posture the symptoms of convulsion disappeared.

The mode in which the suggestion is initiated is not essential to the theory, but it is often important in practice. Commands are usually realized more readily than mere suggestions, but the latter are sometimes the more efficacious. In general, the phenomena differ in degree only and not in kind from those of normal life, and just as a categorical suggestion may be realized at once, so may a hypothetical suggestion be realized under the circumstances indicated by the operator. Most of the illustrations which I have been using belonged to the former type; to the latter belong the still more curious phenomena of deferred and posthypnotic suggestion.

Simple deferred suggestions executed during the state of heightened suggestibility may be dismissed with a mere mention. The really interesting cases are those in which the execution of the suggestion given during a suggestible condition is deferred until the patient has returned to the normal state. As the phenomena have been studied chiefly in hypnotic states, artificially produced deferred suggestions of this kind are termed posthypnotic suggestions.

Analogous phenomena are found, however, as we would expect, under other circumstances. We are familiar, for example, with the effect sometimes wrought by dreams upon the waking life of the succeeding day. A happy mood or its reverse can often be traced to the effect of some vivid dream, and doubtless many of the mornings on which we "get out of bed on the wrong side" have been preceded by nights filled with disagreeable but forgotten dreams. M——, of whom I have before spoken, has given me an excellent illustration of the possible after-effect of a forgotten dream. He once told me that he had been for some months tormented by an apparition. He would wake in the middle of the night to find a hideous man beside him. The man held in his hand a knife, looked at him threateningly, then slowly moved backward, and, when at a considerable distance, vanished. Occasionally he saw in the place of the man a young woman with a black shawl wrapped about her head. He knew that these figures were unreal and had no belief in ghosts, yet they always left him terrified and suffering from nervous shock. I questioned him closely, but could get no clew to their origin. He had never had a dream in which they figured, and had never heard any story that

could have suggested them, save that he had heard when a child of a young woman having been strangled by her lover on the site of his father's barn, out in the country. There was no knife in that case, however, and he was sure it could have nothing to do with the apparitions. I then hypnotized him, and he at once told me the whole story. I had to question him somewhat, but I was keenly alive to the danger of asking leading questions, and am convinced that the story was told spontaneously. The girl had had her throat cut, he said; a coachman had claimed to have seen her ghost in the barn and had told him of it. After that, four or five coachmen in succession declared they had seen the ghost, and left the employ of M——'s father rather than sleep in the barn. M—— was greatly frightened and began dreaming about it. After the lapse of some years the dreams ceased, but about two years ago they began again. *He never saw the apparition,* he said, *except when he had been dreaming about the murder.* I told him he would never have such a dream again and would never see the ghosts. That was in August last, and in November he told me he had had no recurrence. I have not seen him recently. Another most interesting fact in this case was that, although M—— had totally forgotten all this in his waking state before being hypnotized, and although after being awakened he had not the slightest recollection of anything that passed while he was hypnotized, he did then remember most of the facts he had just been talking of and told me them again, expressing surprise that he could not do it when I first asked him.

Now, here we have a true posthypnotic phenomenon. It is precisely parallel to those cases in which the hypnotized patient is told that at a certain time and place, while awake, he will see John Smith, who will say this or that to him; the time comes; a phantom John Smith walks into the room and does what is expected of him. But the state which in M——'s case survived the shock of waking was not a suggested state in the common sense, nor was it revived upon the occurrence of some appointed condition or signal. The story is of interest as showing how purely arbitrary is the line which some writers would draw between the "normal" and "abnormal" in this field.

There are three especially interesting problems connected with posthypnotic suggestion: 1. What is the relation of the suggestion to the signal? 2. In what form does the suggestion exist between the time of awaking, when it is usually unknown to the upper consciousness, and the moment of execution? 3. What is its relation to the upper consciousness in which it reappears?

To the first of these questions no very clear answer can be given. We can say that the suggestion is "associated" with the signal, and it of course is, but that does not explain to my mind

the reason why this dynamic state remains inactive until the signal sets it in operation. In some few cases, when a sensory signal is to call a posthypnotic hallucination into the upper consciousness, we can conceive of the sensory stimulus as the spark necessary to explode the stored-up energy of the cells and raise the idea to sensory level—make a thought seem vivid, intense, and external like a perception. But this conception is of limited application. The signal need not be sensory at all. It may even be a process of the higher orders, such as a perception of resemblance or difference, or even may consist in the lapse of time. I gave T—— some numbers to multiply and told him that if the figures 1 and 4 happened to stand side by side in the course of his work he would tear the whole up. When the numbers appeared in that relation he at once noted it and carefully tore the paper to tiny fragments. It is not easy to conceive of the suggestion as held in check by the mere lack of such a complex process of reasoning as this. Such difficulties I can not, I confess, explain away, and as long as they remain unexplained, the theory with which they are connected can not be accepted as final. It is to avoid them that some writers have introduced the conception of a subconscious personality which hears, remembers, and obeys without reference to the condition of the upper consciousness, and this brings me to the second question.

We usually conceive of our potential memories as existing in the form of a functional predisposition on the part of the nervous mechanism, and as having no actual mental existence while we are not thinking of them. At the first glance one would suppose that the posthypnotic suggestion exists in the same form. But cases have been reported which seem to prove that sometimes at least the posthypnotic suggestion enjoys an actual existence, even while the upper consciousness knows nothing of it. Thus Mr. Gurney says of P——ll, one of his patients: "He was told on March 26th that on the one hundred and twenty-third day from then he was to put a blank sheet of paper in an envelope and send it to a friend of mine whose name and residence he knew but whom he had never seen. The subject was not referred to again until April 18th, when he was hypnotized and asked whether he remembered anything in connection with this gentleman. He at once repeated the order and said: 'This is the twenty-third day; a hundred more.' S——. 'How do you know? Have you noted each day?' P——ll. 'No, it seems natural.' S——. 'Have you thought of it often?' P——ll. 'It generally strikes me in the morning early. Something seems to say to me, You've got to count.' S——. 'Does that happen every day?' P——ll. 'No, not every day, perhaps more like every other day. It goes from my mind; I never think of it during the day. I only know it's got to be done.'"

Here it is conceivable that the counting was merely forgotten and not strictly subconscious; but sometimes the suggestion can be elicited by automatic writing while the upper consciousness is apparently quite normal and entirely unaware of what is written. At other times the subconscious state seems to effect partial union with the upper consciousness. Thus P——ll was told "The baking trade is failing." Next day while awake he put his hand upon the planchette and the instrument slowly produced the words "The baking trade is failing." While the writing was proceeding he said that some one seemed to be "hallooing in his ear something, he could not make out what, about the baking trade." Another of Mr. Gurney's patients, when told to see his wife, thought he saw a face in an air ball. It was dim and soon faded away. Later, the suggestion having been repeated, he said he "saw a lot of faces floating before his eyes" that night. Such cases are precious as throwing light upon the origin of the "spirit voices" and "visions" which many automatists hear and see.

Mr. Gurney also got interesting evidence of subconscious time reckoning. The patient, W——s, was "told in trance on March 19th that, when he came next, he was to poke the fire six minutes after his arrival, and that when he wrote he was to record the number of minutes that had run. On March 21st he arrived at 6.57½, and I set him down to the planchette in about a minute. The writing, which it took about a minute to produce, was '2, —3½ more.' . . . He was told on March 23d that a quarter of an hour after his next arrival he was to open and shut the door of the room and note the course of time as usual. The next time he arrived at 7.6½. He was set to the planchette at 7.19. The writing, produced at once, was '13 minutes and 2 more.'" At 7.22 he executed the suggestion.

Analogous phenomena in normal life are familiar. Many persons, of whom I am one, by giving themselves a suggestion upon going to bed to wake at a given time next morning, can make themselves wake at or about the time appointed. When the time is fixed by habit there is still more striking evidence of subconscious processes. For several months it was my practice to get up at 6.50 every morning. Not only did I usually wake about that time, but I would also often, after lying awake for some time, get out of bed suddenly without any clear intention of doing so or thought of the time. While busily thinking of something else I would suddenly find myself out of bed and beginning to dress; then, looking at my watch, I would find it was within a few minutes of 6.50. There was no striking clock within my hearing or other means of consciously reckoning time, as also there was not n these experiments of Mr. Gurney's.

It is upon such phenomena that the doctrine of subconscious

mental states rests, and to my mind the evidence for their existence is strong. Yet I do not think that we are compelled to infer that all posthypnotic suggestions exist actually nor yet that all potential memories have an actual existence. For the present I would rather regard the subconscious state as something to be accepted only when definite evidence of its existence is forthcoming. Nor would I ascribe these states in all cases to a secondary or subconscious "self," although I regard the existence of such a self distinct from the upper self as in some cases probable. Subconscious states when they do exist are probably like our dreams.

The emergence of the suggested state into the upper consciousness sometimes seems to have no appreciable effect upon its constitution. The new element presents itself to the patient much as other elements do, and may meet with opposition from those already existing as would any other. Thus one of Mr. Gurney's patients "was told to bring the spoons out of the dining room into the drawing room, which was properly the maid's duty. She was left to wake in the dining room, and presently followed the rest of the party into the drawing room, saying, 'I know what you want me to do, but I don't mean to do it; it is too absurd.'" She had no recollection of what she had been told, but when the irrational impulse presented itself she suspected its origin and refused to obey it.

At other times, by a species of illusion of memory, the suggested impulse is referred by the patient to some consideration from which it might very well have sprung. A friend of mine hypnotized a young girl, and told her that when he coughed three times she would say good-night to the assembled company and leave the room as if going to bed, but at the foot of the stairs she would turn back. She did it punctually. When we asked her next day why she changed her mind, she said that as she got to the foot of the stairs it occurred to her how rude it was of her to go to bed while the callers were still there, so she turned back.

When a posthypnotic hallucination presents itself to an approximately normal consciousness of this kind it is received with appropriate emotions, and the same is true of negative hallucinations. X—— was told that after waking he would be blind to me. I then took a pencil and, holding it by one end, wagged it to and fro. The patient stared at it with a puzzled and somewhat frightened air. "There ain't nothing to hold it," he said, "but it stands right up and wags. Guess it must be hung by a string to the ceiling." But a diligent search revealed no string. I then grasped the pencil by two fingers about the middle. He became still more troubled, stooped as near the pencil as he could and examined it closely. "Somehow I can't see the middle of it," he said. "There are just two ends and no middle." It is dangerous to give a

patient of this type an alarming suggestion, for the terror which it inspires may do more mischief than the operator can readily undo.

Sometimes while the upper consciousness is apparently unaffected it will be found that the performance of the suggestion is either forgotten or entirely unnoticed. Prof. Janet says of his patient Lucie: "She seemed at the moment quite normal, talked and kept record well enough of the acts she performed spontaneously, but in the midst of all these normal acts she also performed as if by distraction the acts commanded in sleep. Not only did she forget them when performed like most subjects, but she did not seem to be conscious of them the moment she did them. I tell her to raise her arms over her head after waking. Scarcely is she in her normal condition before she raises her arms above her head, but she does not inconvenience herself thereby. She goes, comes, talks, and all the while keeps her arms overhead. If asked what her arms are doing, she is astonished at such a question and says: 'My hands are doing nothing at all; they are like yours.' By this method I make her put her fingers to her nose and walk across the room. I command her to cry, and upon awaking she actually sobs, but in the midst of her tears talks of the most cheerful matters. The sobs over, there remains not a trace of her grief; indeed, she seems to have been unconscious of it."

These may be regarded as the extreme types, the posthypnotic suggestion in the one case coalescing with the upper consciousness, and in the other remaining absolutely dissociated from it. There remains a third type in which the suggestion emerges into the upper consciousness, but in so doing seems to disordinate it to a greater or less degree, thus reducing the patient to a condition analogous to that in which he was when the suggestion was given.

The disturbance is often very slight and it is then not easy to detect or define it. It may be limited to a transient look of abstraction, of vacancy, as if a cloud were passing over the mind. What I have described as failure to coalesce may be conceived as a form of interference in which the suggested state expels from consciousness all inconsistent states without much affecting the balance. At other times if one gives a suggestion the execution of which takes some time, the patient will be found sensitive to fresh suggestions while the first is being executed, or will be found to recollect at that time previous states of somnambulism which are forgotten in his normal condition and are again forgotten, together with the act just performed, a moment afterward. Sometimes the disturbance of the upper consciousness goes further and results in complete disordination or "unconsciousness." I have often seen this as the result of giving suggestions which were too

difficult for the patient's already partly disordinated consciousness to execute or were resisted by elements already present. A good case of the latter type is quoted by Mr. Gurney from Prof. Delbœuf. "He told the patient to straighten a crooked knitting needle at a future moment when he foresaw that to do so would necessitate drawing the needle out of the stocking and spoiling the work. When the moment arrived she solved the difficulty by going to sleep and *dreaming* that she straightened the needle." I told T—— that he could not see two chairs, and then caused him to walk into them. Asked what impeded his progress, he said "The wall." When I showed him that could not be true, and insisted upon his telling me what it was, he fell into a deep lethargy and collapsed in a heap on the floor. He nearly always falls asleep when told to execute any complicated suggestion. Patients who pass into a secondary state during the execution of a suggestion often manifest no more surprise at the most extraordinary hallucinations than one usually feels when confronted with the marvels of dreamland. T—— described in all detail how a cup of chocolate, which was held by a person I had forbidden him to see, was hanging in the air all alone, how the spoon was traveling around in it quite of its own accord, but he seemed to find it entirely natural. This is due to the fact that surprise is one of the ideal emotions originated in the clash of inconsistent states. Here the hallucination found no sensations or thoughts in the disordinated state with which to clash.

The whole question as to the relation between the posthypnotic suggestion and the normal consciousness is involved in much obscurity, which is the more to be regretted when one considers that upon it depends the solution of that other vexed question as to whether suggestions can be used to further a criminal end.

To the best of my knowledge, no indubitable cases are on record in which a person was impelled by posthypnotic suggestion to the commission of a crime which he would not have committed of his own motion, although there are a few cases reported in which criminal assault was probably committed during the hypnotic state. The evidence, therefore, is almost entirely experimental.

It is clear that the control of the operator over the patient during the hypnotic state is often almost unlimited, and undoubtedly might be used for the commission of crimes which could be completed during the state without danger of detection to the suggester. There are, however, not many crimes that could so be committed. Signatures could be got by such means, but even when got the suggester would often have difficulty in making use of a signature which was not witnessed or which was repudiated as a forgery by the man who was supposed to have written it.

The possibilities of posthypnotic suggestion would seem at first glance to open a wider field for criminal suggestion, but the evidence does not, I think, justify much apprehension on that score.

When the patient's consciousness is much disordinated by the suggestion, he is usually unable to co-ordinate himself to his environment, and is, of course, not fitted to do anything requiring alert mental powers, much less a crime. When the suggested idea expels inconsistent states the case is almost as bad. Prof. Liégeois dissolved a white powder in water and told Mme. C——, one of his patients, that it was arsenic. "I said to her: 'See M. D——, he is thirsty, he is always wanting something to drink; you will offer him this.' 'Yes, monsieur.' But D—— asked a question which I had not foreseen; he asked what was in the glass proffered him. With a candor which set aside all thought of simulation, Mme. C—— replied, 'It is arsenic.'" Clearly it would not do to intrust to Mme. C—— the execution of a suggested crime.

Again, when the emergence of the posthypnotic suggestion does not affect the upper consciousness at all but coalesces with it, it is apt, as I have already pointed out, to meet with resistance from the patient's habitual principles of conduct. Dr. De Jong reports that a little Jewish girl of ten, whom he found very suggestible, repeatedly obeyed his posthypnotic suggestion that she should steal a piece of money left lying upon the table, but one Saturday she disobeyed. When asked why, she said: "It is the Sabbath day; I can not touch money." Another of his patients performed all manner of make-believe crimes at his suggestion, but, when he suggested something the performance of which would have shocked her modesty, she refused, and she refused also to betray a trivial secret which he had got his cook to confide to her.

When one contrasts cases of this sort (and they are common) with the long series of "laboratory crimes" recorded in the annals of hypnotic literature—murder committed with sugared water, with a roll of newspaper, with an unloaded pistol, the theft of purely imaginary objects, or of articles obviously the property of the man who suggests that they be stolen, etc.—it is difficult to avoid the conclusion that for evidential purposes such experiments are almost worthless. And in the few cases where it seems probable that the patient has really committed what he believes to be a crime, it is often not shown that the crime would have been especially abhorrent to his normal self. This objection attaches, I think, to one of the most striking cases on record, recently reported by Prof. Liébeault. A certain Dr. X—— and himself gave a young fellow of seventeen or eighteen years of

age the following suggestion: "To-morrow, at 11.30, you will go to call upon M. F——. You will be received in his room and will see upon the chimney-piece two statuettes; you will carefully possess yourself of them after talking of sundry things, and will carry them off hidden under your clothes. But day after to-morrow you will repent of what you have done, and, seized with remorse, will return the statuettes to M. F—— at about the same time of day." Then, just before Prof. Liébeault awakened the patient, Dr. X—— said: "You will steal, you understand; you will steal." The suggestion was punctually executed. Two months later the boy was arrested for the theft of an overcoat which he took in a very stupid and obvious fashion, and upon his person was found a written list of petty thefts recently committed, among them being that of some visiting cards. Dr. Liébeault, believing that the indeterminate suggestion given by Dr. X—— was at the bottom of the whole matter, got a lawyer to undertake the defense, and secured the diminution of the penalty to two months' imprisonment. Four years later, when the boy came of age, Prof. Liébeault hypnotized him again, his parents not allowing it while he was a minor. In the hypnotic state he claimed that about the time he stole the overcoat "he had met Dr. X—— in the street, had gone with him to a *café*, had been hypnotized and told to steal watches, pocketbooks, gloves, etc." The theft of the overcoat was specifically suggested. This case proves that theft can be occasioned by suggestion, but it does not prove that it could be successfully suggested to an honest and upright patient. For aught that appears, the boy would have stolen if a companion had put the idea in his head in his waking state.

A still better illustration is given by M. Focachon, which I take from Prof. Liégeois: J. D—— is a seamstress, aged twenty-seven, nervous, not hysterical, not very intelligent, uneducated, of recognized honesty. While hypnotized, M. Focachon suggested to her that she should steal from the closet of one of her employers some cloth, should bring it to M. Focachon's house, and should borrow the use of the sewing machine to make it up. "J. D—— at first protested very vigorously, asked what I took her for, wept and begged me to wake her, that she might no longer hear such propositions, but quieting her little by little, minimizing the importance of the theft, telling her it would never be known, and playing upon her vanity, I finally got her to say she would think about it." The suggestion was obeyed, but before she made the goods up M. Focachon hypnotized her again, took it from her, and abolished her recollection of the whole matter.

If such cases put it beyond question that suggestion may be used for the performance of crime, they also, I think, make it evident that the danger is not one of great magnitude. If there

are in the community a few individuals who, although of good natural disposition, are so weak that they can be used as passive instruments for the performance of crimes, there are probably very few of them; those few are seldom known; if known, they will seldom fall into the hands of a person inclined to abuse their weakness, and, if they do, the part played by the hypnotizer will frequently be detected.

But if the dangers of criminal suggestion do not appear serious, there is a real danger connected with its possibility. The plea of "emotional insanity" often adopted by sympathetic juries is becoming somewhat timeworn, and in hypnotic suggestion adroit lawyers may find an even more dangerous substitute. Suppose, for example, that A—— is accused of a crime for which no adequate motive can be shown. But B—— had a motive for its commission; B—— is acquainted with the phenomena of suggestion, A——is known to be extremely suggestible, and B—— has had ample opportunity of influencing him. In such a case no amount of evidence that A—— committed the crime could set aside in my mind a "reasonable doubt" of A——'s guilt. The occasional escape of a criminal on this pretext I would not regard as a great matter, but the stigma which his acquittal would cast upon B——, a stigma not the less real because incapable of proof or disproof, is a serious thing.

A similar line of reasoning has been used once at least with what seem to me more happy results. On the 25th of January, 1888, a young married woman—Mme. G——, the wife of a French engineer living in Algiers, and said to be one of the most beautiful women in the country—was found lying dead not far from her home, with two bullets through her head. Near by lay a man named Chambige, a friend of her husband's, seriously wounded but living. Chambige claimed that Mme. G—— had been in love with him and he with her, and that they had agreed, in view of the hopelessness of their passion, to die together; he had shot her first and then himself. There was not a shred of evidence to show that Mme. G—— had ever had more than a friendly regard for Chambige, mingled perhaps with the pity a happy woman feels for a lonely and disappointed man. To all appearance she had always been a most loving and virtuous wife, with no thought for anything but her husband and children. It was proved that on the day of her death she had seemed as placid and cheerful as usual, showing not a sign of mental perturbation; that she was in the highest degree hypnotizable and suggestible, and had frequently unwittingly hypnotized herself by looking too long at a fixed point. It was also shown that Chambige had been madly in love with her, that he probably was acquainted with hypnotism, that he was a restless and unbalanced spirit

without religion and without morality. Prof. Liégeois, of the Faculty of Law at Nancy, has published a study of the case, in which he endeavors to show that Mme. G—— was in all probability innocent, that Chambige hypnotized her in the parlor of her own home on the morning of the day of her murder, and then lured her to ruin and death by a posthypnotic suggestion. No one, I think, who is at all acquainted with the possibilities of suggestion will deny that Prof. Liégeois's interpretation is within the realm of possibility, and for my own part I am inclined to regard it as more probable than the tale told by Chambige. If the theory of suggestion had done no more than clear this young wife's memory from the stain cast upon it by her murderer, it would be worthy of serious consideration.

To sum up, I believe, with Prof. Delbœuf, that the danger from criminal suggestions, although real, is not much greater than that arising from criminal dreams. It is known that crimes have been committed by somnambulists as the result of the dreams which possess and control them, but we do not regard the fact as a reasonable ground of apprehension. We can not lay too much stress upon the fact that the phenomena of hypnotic suggestion, strange as they appear to the uninitiated, find their nearest normal analogues in those of sleep and dreams, and are subject to much the same limitations.

WOMAN AND THE BALLOT.

By ALICE B. TWEEDY.

IF every man considered it a matter of conscience to give voice in his vote to the feminine element in his household, it would put another aspect upon the demand for woman suffrage. If, after a family conclave, the husband, father, or brother quietly pocketed his own conflicting opinion, sallied forth and supported the measures favored by the home majority, what right-minded woman could complain? It would be merely an extension of the main principle of republican government. Only those women without male relatives would be unrepresented, and for them special provision could be made.

This hypothetical condition, however, is so far from fact that it sounds facetious, and the picture of a household wherein a gentle-minded man revises his sentiments to adequately set forth the contrary views of his womankind seems altogether Utopian, yet such a situation is one in which it might be justly claimed that men were the actual political representatives of women.

Some men there are, though *rarissimæ aves*, fair enough to

acknowledge that woman ought to be represented in this fashion, or else allowed to deposit a ballot for herself. The proposition of woman suffrage alone does not trouble them, but they stumble over the corollaries of political life and officeholding, and, rightly judging that the trio are logically involved and claimed by suffragists, they demur at the result or reject all together.

Political avocations seem to them utterly alien to the womanly nature, or at least to what they know of it; and since their conception of this elusive quality is undoubtedly founded on the particular instances which have fallen within their experience, it would be useless to oppose it with a flurry of words. One of their number, however, in a paper on The Political Rights and Duties of Woman, is explicit, and furnishes us with several statements which may be debated. To the performance of political functions by women, he holds there is "a serious natural impediment" that "four fifths of the women all the world over, between the ages of twenty and sixty, are occupied with paramount domestic obligations incompatible with public service." "Under this disability of Nature, or closely related to it, all the objections to the exercise of political functions by women may be classed, so that no other objection need be considered."

It is no longer, then, a vaporous theory that confronts us, but an array of questionable facts. The condition of four fifths of the women "all the world over" is certainly beside the issue. We have no reliable statistics regarding them, and we are not at present concerned with their political disabilities. The ballot is demanded only for the women of civilized communities, where the right of suffrage is already possessed by men, and the question is immediately pertinent to those in the United States. Here statistics are available, and in New York State they run as follows:

Women between the ages of nineteen and sixty-five.

Total number		1,707,655
Married women	1,244,291	
Mothers *	1,238,070	
Mothers disqualified for public service		550,252
Eligible women		1,157,403
= 67 per cent of the whole.		

Comparing men, we find certain classes among them ineligible to political office by reason of their professional or business duties, yet disfranchisement of their sex on that account has never been considered. Priests and ministers of the gospel, even if devoting some time to politics, could not give to public office "that entirety

* The general proportion of mothers among married women is ninety-five per cent. Of these, the maximum number disqualified would be four ninths.

of energy which an official oath exacts" without disregarding the spiritual welfare of their flocks; and if they are true pastors, it would not be amiss to compare them in the multiplicity of their cares to the mothers of young families. Physicians in active practice can not well be judges or sheriffs without neglecting the vocation for which they are especially fitted. Scientific men engaged in original research are not expected to abandon their laboratories, where they may be on the eve of bringing forth the fruit of lives wedded to patient observation, even if a mistaken populace should nominate them for mayors or Congressmen. Manufacturers and business men have even been known to decline senatorial honors, since these conflicted with the responsibilities of their callings.

If a count could be made of all these men who, for various reasons, will not accept political candidacy, it might be found to equal in number the mothers who are disqualified for office-holding.

It is to be observed that at any given time only a minority of mothers are even thus conditioned. That four fifths of womankind between the ages of twenty and sixty are ineligible for public office proves thus to be an exaggeration.

Planted upon this astounding proposition, our antisuffragist then proceeds to discuss the complications that may arise if women enter upon political life. While they attend committee meetings, the scarlet fever may invade the nursery. If they engage in jury duty, the husband, fretted with financial cares, will fail to find sympathy at home.

It may be presumed that women with young children will not generally accept candidacy for public office; but should they in some cases think best to do so, such contingencies are not unlike those that occur outside of political life. A wife is called to the bedside of a dying mother, one thousand miles away. She leaves her children; the measles breaks out among them, and the father, although an inexperienced man, nurses the flock back to health. Instances are not wanting in which men have wrestled victoriously also with other diseases, so that a great gloom need not settle down upon mankind at the prospect of a mother's occasional attendance upon a committee meeting.

The dearth of sympathy at home is no matter for jesting. No doubt thousands of women, in times of anxiety, have gone entirely unconsoled while their husbands were jurymen. If men have a taste of this experience, where is the injustice?

Not very relevantly our opponent breaks in here with the assertion that "the suffrage is a question of readjusting the occupations of men and women as established by all civilized and uncivilized people." As the occupations of men and women *vary* with

the state of civilization and the industrial development of a country, this generalization is valueless. The employments of men and women also depend upon the condition of the nation, whether militant or peaceful, and in regard to certain kinds of work no universal rule can be made. Women act as horse-car conductors in South America; Chinamen prefer the laundry in the United States; while in East Central Africa men insist upon sewing their own and their wives' garments, leaving the women to build the houses and hoe the corn. The modern readjustment of vocation in our midst arises, as it has been pointed out, from the increased leisure afforded women by the introduction of machinery. It is a wonderful evolution for woman, proceeding as noiselessly as the spinning of countless cocoons, liberating many who would have grubbed a hundred years ago to try their wings to-day if they will.

The next statement volleyed at us is very like an explosive used by Mrs. Lynn Linton in one of her harangues against women.* "The political disability is one irrevocably connected with that very office and *raison d'être* which called woman into existence."

Despite our advancement in science it seems next to impossible to extricate some minds from the mire of tradition. Brushing biology and common sense aside, these primitive souls continue to regard woman as the mythical rib of Adam. Those of us who have progressed beyond this dogma look upon it just as flatly contradictory to Nature as the biblical view of the earth as a plane. Woman's sexual life is shorter than that of man, her individual life longer. Therefore, if either was "called into existence" for the office of parenthood, it was obviously the man, not the woman. From a biological point of view the functions of life are two—nutrition and reproduction; and there is as much sense in saying that nutrition is the reason of man's existence as to state that motherhood—if that be "the office" meant—is the "*raison d'être*" for women.

As for us, we frankly confess we do not know anything about "reasons of being" or causes of existence. If Mrs. Lynn Linton, Mr. Talbot, *et al.*, have been taken into the creative confidence, no doubt they have interesting revelations to offer the world!

Our antisuffragist, not being quite content with delving into prehistoric purposes, next hazards a prophecy of the feminine officeholder. As wives and mothers are, according to his premises, ineligible, only "those who have made shipwreck of their domestic ventures," the forlorn and *déclassées*, will pose as nominees.

* The Wild Women as Politicians. Mrs. E. Lynn Linton. Nineteenth Century, July, 1891.

He provides, however, "a contingent disability," that of getting married, which may overtake these. As our prophet waxes eloquent over matrimony he forgets what manner of woman he has pictured as a politician, and tells us "only intelligent and agreeable women will be popular, and only popular women would be candidates and elected." The forlorn and *déclassée* woman is metamorphosed into "the brilliant, educated, and accomplished lady stump speaker," and when she marries, what can be left for the suffragists?

Having thus disposed of the phantasmagoria of his creation, he asks two momentous questions:

1. What wrongs are there affecting society which the women's vote will set right?

2. What oppression does woman suffer at the hands of man which she must rise in her might to redress?

I am not aware that woman suffrage is proposed as a panacea for social evils, or that it will usher in a millennial condition. Man would be disfranchised if such requirement was made of his vote. Legislation does not beget character, and man is not made temperate and pure by law. Stringent laws, however, are needed to prevent various evils and to make certain offenses punishable. Women are quick to recognize vicious tendencies that men with a greed for money-getting often overlook. The work of Mrs. Fawcett in England, and of many earnest women in the United States, shows what good would accrue to society if women helped to frame the laws.

Our opponent does not pause to consider whether woman's vote would be beneficial or not to the community, but spends his full strength in fortifying the second query. "The woman's grievance against man, what is it?" he asks. "The moment you attempt to inflate its emptiness . . . you are dealing with hysteric fancies rather than hard facts. . . . Woman has no grievance against man. . . . Cruel Nature has committed an offense against woman."

English law is more nearly defined as "a hard fact" than as "a hysteric fancy," and English law contains a long "bill of grievances" which woman may publish against man.* True, in this land of boasted freedom most of these laws have been repealed, many others are a dead letter, and still others have been enacted that favor woman. These changes have been brought about by the growth of the sense of justice, but also directly through the efforts of women agitators who have pleaded and written against decrees of oppression. These writings and arguments are a matter of record, and they antedate all betterment of

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* John Stuart Mill. Subjection of Woman, pp. 56–58.

the laws relating to women. Without them we do not know when "man's own sense of equity and right" would have impelled him to annul the obnoxious statutes. Even here in New York we come occasionally upon instances which betray the defects of a masculine code;* while in the civilized countries of Europe the laws generally discriminate in man's favor.

Outside of unjust enactments, the former subjection of woman is stamped on our customs, our literature, and our language. It is hardly possible for any one to investigate the origin of many of our conventionalities, titles, terms of obloquy, without coming unexpectedly upon proof of man's injustice to woman.

It is not intended to reproach the present generation of men for these or any other sins of their forefathers, as I hold all antagonism of the sexes as unnatural and vicious. Had women possessed the physical force, I think it very likely they would have acted as badly as their male ancestors. Yet it is instructive to note the tendencies and results of abuse of power, and an exclusive manhood suffrage is in this age and country a retention of power unwarranted by reason.

In primeval society, our antisuffragist allows that "the male and female were more nearly balanced in what each was called upon to endure." He adds that, although civilization has improved the lot of man, it has not "redeemed woman from the primitive sufferings by which she consecrated her motherhood." As to what sufferings primitive woman had I do not feel quite sure, but can agree that civilization has not yet accomplished a physical redemption for woman, although it is now alive to the fact that she has a physique to be developed. On the contrary, it has hitherto distorted her and artificially increased her weakness under the pretense of differentiating her from man. Her own stupidity and vanity are occasionally at fault, but man is not guiltless, and if another distinct grievance is wished for, it is here. Nature is not cruel; according to the words of the old hymn, "only man is vile." Let us say instead, man is a blunderer.

Our opponent reaches at length his principal tenet: women are a privileged class. Their privileges consist not in the minor courtesies of life, but in various immunities and exemptions which are "a generous attempt on the part of men to make for their mates and yoke-fellows an easier pathway through a rugged world. . . . Having in the right of his strength the opportunity to determine the customs of society, he has exempted his mate from

* A woman appointed administratrix refused to pay an exorbitant bill. Her arrest for contempt of court resulted in the death of her babe. The surrogate said it was a case of great injustice, but the code made it mandatory upon him to issue the order (New York Times, June 11, 1890).

all those vocations that expose to premature death or great physical suffering." An inventory of these exemptions follows:

1. From the perils, wounds, and deaths incident to war.

2. From all kinds of labor dangerous to life or exposing to hardship and privation.

3. From the care of earning her livelihood and that of her offspring.

One is at first sight aghast at this record of masculine arrogance. Women might retort, and say Men have exempted themselves—

1. From the care of their progeny.

2. From the preparation of clothes, food, and household toil.

3. From nursing the sick.

All these "exemptions" are misnomers. Men have "exempted" women from nothing. They have excluded women in former times, and still exclude them in some degree, from the higher institutions of learning, the professions, and government. These exclusions, however, would form another "bill of grievances." The immunities mentioned are purely imaginary. Man *chooses* to fight, to sail the seas, to dig for gold and iron, to hew wood, and cut his own pathway in the world because he is a man and likes it, not to save any woman nor womankind from such tasks. He has the combative instinct that greets a struggle, the well-knit muscles that crave vigorous action, the adventurous spirit that courts the unknown, and the courage that defies danger. Does a boy wrestle with his playfellow to spare his sister; or run away to sea, or to the gold mines of South Africa, from an altruistic feeling for womankind?

Neither do men go to war or enter upon any dangerous calling with the purpose of exempting women. When John takes the peach and hands Jane the apple, we do not say, "Jane is exempted from eating the peach." Were all womankind swept from the earth to-morrow, men would not bury their weapons nor let the ships drift. Love of the other sex is a spur to the endeavor of either, but the choice of occupations calling for physical force is instinctive with the sex possessing it in greatest degree. All intellectual pursuits are feminizing in tendency, and it is only with men engaged in these, only with the smaller number among them who have allowed their masculine instincts to become atrophied, that the fallacy of "exemption" would take root. The wrestler, the sailor, the Alpine hunter, the blacksmith, would laugh such a creed to scorn. Men have not exempted women from deeds of force, from war, from labor, nor from self-support. They have generally chosen these offices for themselves, and left women to do the things that were left undone.

Woman is not only weighted by these gratuitous immunities,

but, according to this document, her natural delicacy is owing to them, and she is warned that she may part with womanhood if she persists in her unnatural endeavor to change her occupations. The bee is cited as an example that "sex itself may be determined by continuous special regimen or diet."

Now, so far as any naturalist has observed, sex is not *altered* * by any regimen or diet; and as the subject of our inquiry is not a neutral bit of protoplasm, but a developed individual, woman, we do not need to study the origin of her differentiation so much as its possible modification.

The bees, with instinctive wisdom, feed the male and female larvæ differently, just as we, regardful of distinct uses, furnish varying food to the cow and ox. Yet, as the utmost change in nutrition does not result in transference of function in the mature organism, we need not fear that a different environment will ever rob woman of her essential womanhood. This specter, used to frighten girls from a higher education, is still the favorite totem of the tribe of viriolaters.

Our antisuffragist falls into another grave error when he seeks for "the instinctive tendencies of the dominant sex" in an era and in localities where woman has partial sway. It is not generally in the United States—certainly not in a city of New England—that we should look for the gross masculine ignorance that makes woman a beast of burden. It is in primitive communities that the anthropologist investigates the habits of man as the best exponents of his natural instincts. If we find in all such states of society the male is not inclined to relieve the female from hardship and toil, we can hardly argue that the divisions of labor found among civilized people arise from man's wish to exempt his mate from the arduous tasks of life. The Russian mother toiling in the fields, the Viennese woman laying bricks, the peasant girl harnessed to a cart, are better instances of man's "instinctive tendencies" than any to be found in American cities, where men have learned in some degree to subordinate instinct to reason.

Yet if one, being a woman, was forced to choose between toil in the fields, laying bricks in the sun, or a day at the washtub, it is not altogether certain that the last would be regarded as a privilege. It is possible that some women might prefer the first employments and desire exemption from the scrubbing-board. Moreover, if a child is needed to complicate the case, its chances of life may be vastly better with the flies in the open air than with the germ-laden atmosphere of a tenement.

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* The genesis of sex in certain orders seems to depend upon differing temperature and nutrition.

Thousands of women work in the mines of Belgium, England, and Cornwall.* In the first-named country they formerly worked from twelve to sixteen hours a day, with no Sunday rest.† The linen-thread spinners of New Jersey, according to the report of the Labor Commissioner, are "in one branch of the industry compelled to stand on a stone floor in water the year round, most of the time barefoot, with a spray of water from a revolving cylinder flying constantly against the breast; and the coldest night in winter, as well as the warmest in summer, these poor creatures must go to their homes with water dripping from their underclothing along their path, because there could not be space or a few moments allowed them wherein to change their clothing." ‡ Yet women are "exempted" from labor attended by hardship!

Despite these washerwomen, miners, and linen-thread spinners, we are told "it is woman's privilege generally to be exempted from the care of earning her livelihood and that of her offspring."

It would seem to be time that this libel upon woman should be scorned by fair-minded men. From all antiquity the majority of women have been faithful workers, rendering a full equivalent in labor for their scanty share of the world's goods. The origin of every industry bears testimony to this. In our own era, while women were still homekeepers, did they not earn their livelihood? What was the weaving, the sewing, the cooking, the doctoring, the nursing, the child-care, "the work that was never done," if it was not *earning* a subsistence? Even in these days, when woman goes forth and receives the reward of her labor as publicly as man, she is no more worthy of her hire.# Her ancestress—sweet and saintly soul!—did not dream of recompense. ‖ But was it not her due; and shall we refuse to credit it because man was then a self-sufficient ignoramus who deemed himself the only one fit to acquire property?

One by one the old industries have been transplanted from the home, and still man constructs new schemes of enterprise from the little tasks that once rounded out woman's day of toil. In the

* Census of England and Wales, 1891, vol. cvi, table 6. Miners, female—*coal*, 3,267; *copper*, *lead*, *tin*, and *ironstone*, 1,425.

† *Vide* Report of Reichstag, 1889, forbidding women to work in the mines of Belgium on Sunday and at night.

‡ Report of Bureau of Labor, State of New Jersey, 1888.

"The never-ceasing industry of the women was the principal factor in the development of a manufacture that was probably contributing more directly to the personal prosperity and comfort of the people than any other then in existence in 1790" (Industrial Evolution in the United States, p. 20). Carroll D. Wright.

‖ Women colonists rarely worked for wages; . . . they carded the wool, spun the yarn, and wove the cloth for the male members of the family. In many instances they worked on the land, and did their share in every way to enable the family not only to secure a livelihood but to build itself upon stable lines (Industrial Evolution in the United States, p. 112).

census of 1890, three hundred and sixty-nine groups of industrial work are enumerated, and in all but nine of these women are employed, the actual ratio of women workers to men being 1 to 4·4. The United States Commissioner of Labor writes: "A careful examination of the actual earnings of women discloses the fact that in many industries their average earnings equal or exceed the earnings of the men."

It may be difficult for those not conversant with manufacturing towns to realize that as far back as 1850 there were over two hundred and twenty-five thousand women engaged in factory work, or 27·30 per cent of the whole number of employees. To-day, however, when women have swarmed into nearly all hives of labor, statistics are scarcely needed to prove that, whether "exempted" or not, they earn their livelihood in visible fashion. Dr. Mary Putnam Jacobi asks the observer to "station himself on Broadway at six o'clock in the evening and watch the crowds pouring out of the retail stores, the binderies, printing establishments, and newspaper offices, or to visit the ring of ferries encircling the city, and analyze into their component sexes the vast throngs returning from work; or, at the station of some manufacturing town, see the operatives disembarking for the day, and after such inspection he will find it hard to believe that any women remain at home to sew, dust, sweep, or mind the babies. . . . To his imagination the women of leisure would disappear as completely as in the United States the men of leisure are wiped out of the national census."

This phase of the industrial evolution is unrecognized by our antisuffragist, and he depicts for us how a census-taker would find the sexes relatively employed—the man going to work and the women engaged at home in household supervision and social duties. He admits that now and then women teach, act as clerks, or do literary work, but these are exceptions.* "In the healthy normal society the true order seems to be that 'men must work and women must weep,' unless a cheerful temperament converts the weeping into a song." This, which might answer for a poetical view of the lives of the fisher-folk of whom it was written, was not typical of the general social condition even in Charles Kingsley's time. To-day it is not true of a respectable fraction. The number of women who live in absolute leisure is an insignificant item and is constantly diminishing.

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* The percentage of women workers for the United States in 1880 was forty-nine. In 1890 the gain is stated to be ten per cent. The number of women employed in mechanical and manufacturing industries for 1890 was 505,712. They received as wages $139,329,-719. There are 549,804 women in New York city over fifteen years of age. Those regularly employed number over 250,000.

It is not the casualties of life nor of business that drive women as a class into industrial occupations, but the constant inventions that liberate their time, once useful in the house. Woman's work has always been one of the main stays of the home, although men have cherished the fiction that they "supported" it. Now that man has laid violent hands on woman's former employments—cutting children's garments by machinery, baking, pickling, and preserving for the nation—it is inconceivable that woman, industrious woman, should fold her hands and sit in a corner. She has gone forth and sought for work; she has become "an economic factor," and this status is the *precedent,* not the *consequent,* of the ballot.

We are, however, informed that "women want the ballot in order that they may open to themselves a free career in all the professions and occupations in which men are engaged. . . . They wish to make *wounds* which the present social structure now receives its chronic status."

This diagnosis is faulty, the caution too late. The wounds were rifts in the larval envelope that woman has cast from her. She asks recognition now in the new order to which she is admitted.

It is to be deprecated that individualism in seeking its due should overlook what it owes to others. Women, in the past at least, have sought much more actively for duties than for rights, so that it is superserviceable for a man to suggest this course to them. Even yet some women need to be informed that they have any rights, such rights as the Constitution of the United States avers belong to every man—life, liberty, and the pursuit of happiness.

Our antisuffragist again brings forth the bugaboo which is dear to the conservative heart: the threat of unsexing woman.

"The inevitable ultimate result of subjecting the two human sexes to the same labors, the same employments, the same cares, will be just the same as when domestic animals have been subjected for long periods to the same conditions. Sexual differences, physical and mental, will tend to disappear, and the two branches of the race will tend to approximate a common type."

We can safely let the matter of sex rest entirely with Nature. It is a fundamental fact of our being, not to be disturbed by any little transformation scenes that we can bring about. We may go for analogies to the domestic animals, birds, or fishes, and in none of them will we find *sexual differences* disappearing or tending to disappear. What are called secondary sexual characteristics are very fickle in their nature, and do for various reasons often desert the sex with which they are identified. These are characters

merely associated with one sex but having no essential connection with the sex itself, such as the brilliant plumage of the peacock, or, as Mr. Darwin suggested, the baldness of Englishmen. These in a majority of instances depend upon the preferences of the opposite sex, the last example being a probable exception. So men have only themselves to blame if an undesirable type of woman persists.

In addition to these, artificial differences, mere resultants of specific treatment, may also disappear. The foot of a Chinese woman is quite unlike that of a man, and possibly an aristocratic Celestial dame would be fearful of approaching the masculine type if she allowed her daughter's feet a natural development. Barbarous nations are not usually content with Nature; they delight in differentiating their women from men by blackening their teeth or boring holes in their lips, ears, and noses. We follow their fashions in a mild way and have created several artificial types of women, but it is hardly scientific to call the exaggerations which distinguish them "sexual differences."

Among animals we can, by breeding and training* through several generations, increase desirable qualities, such as the pace of horses or flight of pigeons, but it is not claimed by any breeder or zoölogist that the sexes are any nearer each other than they were in protozoan times. It is also an assumption to declare that the "graces of womanhood—affection, tenderness, and sympathy"—have sprung from the relation of the sexes. According to all authorities, the general relation of the sexes in all but recent times has been characterized by anything but "affection, tenderness, and sympathy." So far as we have proof of the origin of these qualities, they have arisen from the offices of motherhood; and just in the degree that we elevate, ennoble, and endow the mother with moral, mental, and political responsibility, do we put it in her power to exercise the wisest affection toward her offspring, the fullest sympathy with her mate.

Our antisuffragist "fears to drag woman from her high estate wherein man is her servant." This has for me the melodramatic ring of "a hysteric fancy." With all the opportunities for progress which recent years have given her, it does not appear to me that woman is yet on so high a plane as man. She is, however, climbing step by step, and all unprejudiced men and women will welcome the day when she may stand beside him as his coworker in life. That the ballot, officeholding, or any other right which she can exercise or pursuit which she will undertake can render her less a woman, is a hypothesis without a grain of evidence. No

* In every case of change, breeding is certified to be more potent than mere conditioning; *vide* Alfred Russel Wallace, in the Popular Science Monthly, vol. xxxviii, p. 94.

biologist can hold it with any consistency. Over and over again such a result was predicted of education. As she was not educated out of womanhood, so she can not be metamorphosed by politics, and will remain, when acknowledged as an individual, still the counterpart of man.

THE SUBTERRANEAN RIVER MIDROÏ.

By Dr. PAUL RAYMOND.

THE investigations in palethnology which I have been pursuing for several years in the departments of Gard, Ardèche, and Vaucluse, France, have led me to explore the subterranean cavities, avens, caverns, and rivers which furrow the region of the Causses. In this way I discovered, in 1894, the subterranean river of Midroï, and found it so curious that I am impelled to describe it for those who are interested in explorations of the depths of the earth. The river Midroï is situated on the left bank of the cañon of the Ardèche, at the beginning of the defile of la Madeleine. Its mouth, marked by the rich vegetation that clothes the rocks around, is at a level of about twenty-feet above the average height of the river. Starting to explore this river on August 28, 1895, and carrying our instruments, our photographic apparatus, and our boat, the Microbe, with considerable difficulty across the slippery clay bottom, we passed into a gallery about thirteen feet long and ten feet high, contracting in some places to a few inches, which offered nothing of special interest. About one hundred and fifty yards farther on we came to a lake, where my progress had been stopped in a visit made to this place the year before. Launching the Microbe, we proceeded on our way to the unknown. We advanced between walls smooth and polished by the water upon this new Styx, which had a uniform depth of about ten feet (Fig. 1). After a few turns the lake became narrower; an arcade, and then a second, rose before us—the Gate of Mycenæ (*Porte de Mycènes*), as we called them, standing at the entrance to the second gallery. This was the end of the lake, and for the present of our sail. Making the boat fast at the first arcade, we lifted ourselves upon the second, straddling the terminal part of the lake where the slightest slip would have thrown us into it, and entered the second gallery among slender stalactite columns, finely notched on the edges (*stalagmite des crénelures*). A change of direction, and we were in the hall of the Dome (*Escaliers des Stalagmites* and *Salle de Bifurcation*), the vault of which is more than thirty feet high. The gallery forks here, one part going due north, the other part opening opposite,

toward the south (Fig. 1). First a wall of stalagmite barred our road; then we had to scramble over a series of pot-holes, some of which were full of water; and we then entered the passage of the bowlders, enormous blocks fallen from the roof or the walls and

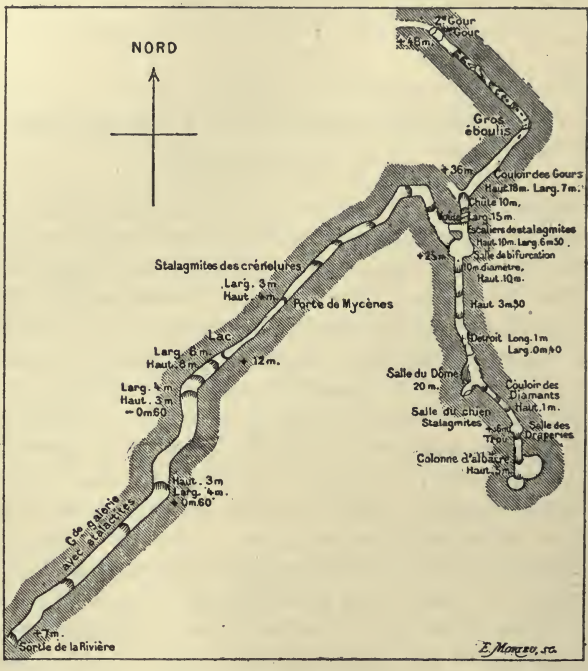

FIG. 1.—PLAN OF THE SUBTERRANEAN RIVER MIDROÏ. (Drawn by the author.)

carried along by the waters, worn and polished, which were chaotically piled upon one another along the rapid descent (*Couloir des Gours* and *Gros Éboulis*). Around these blocks we walked upon a shingle of small worn fragments of stalactite, flattened by the violence of the waters. There was still a pot-hole more than six feet deep separated from another lake by a mass of stalagmites on which we would have to balance ourselves in order to hoist the boat. It was so narrow that we could not do this, and we had to invent a novel system of ballistics to get the Microbe, which was upward of two hundred yards away, through the difficult passage. And it was very vexing to be stopped, for in a moment the river turned to the west, toward the Rochemale Spring, which we regarded as an issue of the Midroï. With all requisite precautions we took up specimens of the water from this pot-hole, which we planted in culture tubes for the microbiological researches we were prosecuting on the water of caverns. The thermometer, which marked 29° C. outside, had fallen to 14° C.

The barometer indicated that we were one hundred and forty-three feet above the mouth of the river—a considerable fall in a course of eleven hundred and forty feet. After a few moments of rest, we turned back, and, crossing the hall of the Dome, we engaged ourselves with the southern gallery, which presented quite a fairy spectacle. In this succession of little halls connected by narrow passages, where we had to pass creeping, the stalactites were crowded in front of us, innumerable, resplendent, lengthening out into slender spindles, graceful little columns, and marvelous pendants, intact and immaculate. A few steps farther on, in the Diamond passage (*Couloir des Diamants*), the spectacle became grand. The roof, the walls, and even the ground were tapestried with crystals cut in facets, which shone under our lamps in dazzling brightness. While absorbed in the scene from the Thousand and One Nights, I heard my boatman Suau cry out, "Monsieur, there is a dog!" and then (*Salle du Chien*), in the half-light of the back of the hall, I saw it in my turn. It was sitting down and looked at us, but did not rise as we neared it;

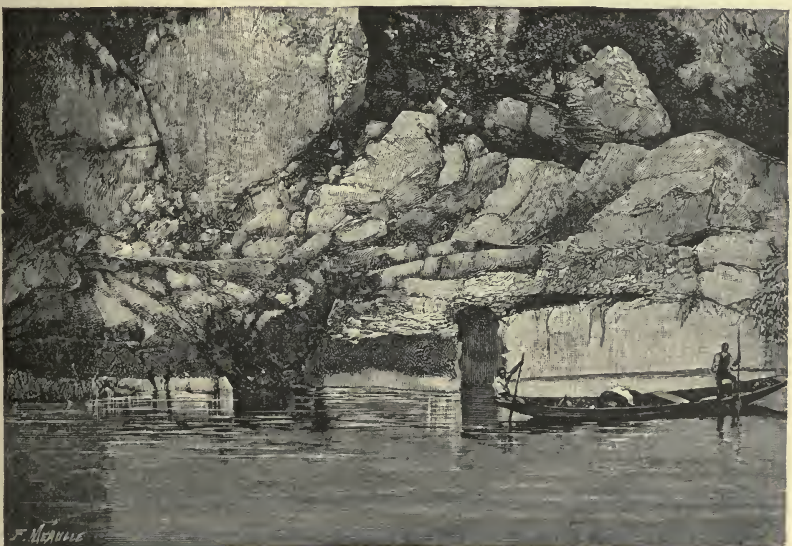

Fig. 2.—The Subterranean River Midroï (Ardèche, France).
(From a photograph.)

it was a block of stalagmite, which quite deceived us for a few seconds. Having recovered from our surprise, we examined the hall, passing from enchantment to enchantment. From the roof hung broad curtains of stalactite nearly ten feet long, and separated from one another by only a few inches, just enough to permit us to put our lamp between them. They

were so thin as to be translucent, and we caught the minutest details of their structure, the result of the long work of centuries (*Salle de Draperies*). Accordingly as the calcareous waters were or were not charged with salts of iron, bands alternately brown and white were deposited the whole length of the veil, simulating, in their regularity, the stripes of the richest tissues of the most complete factories. This hall, of all the caves I have visited, left the strongest impression of the marvels to be met with in the bosom of the earth. Leaving this Hall of Draperies with regret, we continued our march, but were soon stopped, for the river went no farther on this side. We had traversed nearly five hundred and fifty yards in this resplendent cavern, and were now fifty yards above the mouth of the river. Before returning we took a second specimen of water for our studies. It came from a drip which would certainly in less than a year have caused the junction of a stalactite and a stalagmite, and never had we better observed the phenomenon of the union of calcareous concretions. A third specimen was taken from the dripping roof. As we have mentioned these microbic studies, we will also speak of the results we obtained.

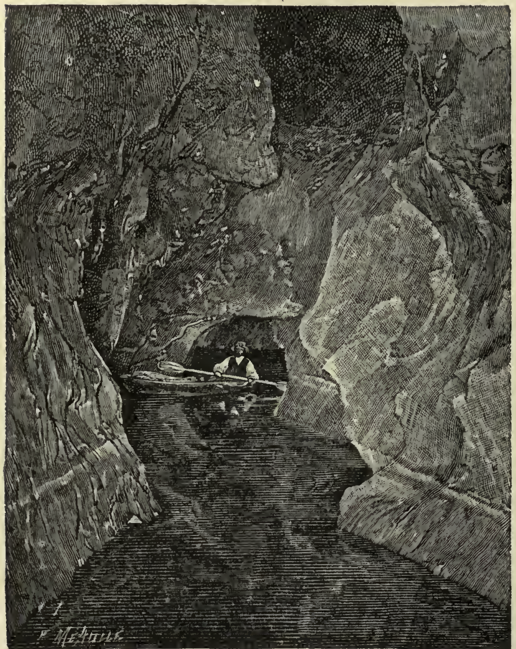

Fig. 3.—A Passage in the Subterranean River Midroï. (From a photograph.)

As a general thing, the culture tubes in which the water from the dripping roof, stalactites in course of formation, and pot-holes in which the water had not been stirred for a long time was put, remained sterile—that is, did not contain microbes. But when we examined a drop of water from the vents, or those fine springs that escape from the fissures, or from the pot-holes or lakes of these subterranean rivers, colonies of microbes were developed; the calcareous filter is no longer sufficient, and while it stops the coarse impurities of the waters that fall on the plateau, it lets the

infinitely small ones like the microbes pass. Although the thickness of the calcareous mass here exceeds eight hundred feet, the filter is not homogeneous, but is fissured; and through these faults, these cracks, in which the circulation is yet slow enough for the water, coming in muddy at the level of the plateau, to issue at the spring with admirable purity, the microbes continue to percolate. It is true that the microbes I have found are not pathogenic, but the importance of the studies can nevertheless be comprehended. If common microbes, brought in by the waters that fall on the plateau, can be found eight hundred feet below it, there is nothing to prevent noxious microbes—those, for example, of typhoid fever, diphtheria, or cholera—which may live in the water from being found there. There is in this a very interesting problem of hygiene and public prophylaxis. We should, then, be suspicious of these beautiful crystalline springs when there are epidemics on the plateau from which they come. They may contain micro-organisms—some indifferent, others dangerous. The microbes which I found belong to the genus micrococcus. Two of them (*Micrococcus aurentiacus* and *M. citreus*) developed in fine colonies of orange and citron-yellow colors; a third (*M. aquatilis*) gave no coloring matter. I obtained microbic colonies after the twentieth hour.

What, in short, is this underground river Midroï (Fig. 2)? A large fissure through which flow the waters drawn from the plateau by the avens, orifices, and cavities of every kind which make an enormous sponge of the mass of the Causses. In past centuries, when the mass of water that fell on the Causses was considerable, Midroï acted regularly and gradually enlarged the fissure; but now it acts only intermittently. Its vent then affords it sufficient outlet. Let me speak of this vent, the fine spring of Rochemale, which issues from the rock a little more than one hundred yards west of the orifice of Midroï. By this narrow fault, the communication of which with Midroï is highly probable, although it is not demonstrated, two hundred and twenty thousand litres of water escape every hour. In case the supply is doubled after great rains, the water, which can not escape by Rochemale in so large a quantity and in the same lapse of time, rises and fills all the meshes of the sponge. If the supply is increased again, the water flows into the river Midroï, which then comes into operation and the level of which may rise several yards, as is shown by the traces of wash-marks left by recent inundations on the walls of the river and which are shown in our photograph. There exists, in effect, in the very heart of the Causses, a considerable and eminently variable reservoir of water; it is a real lake, and through the thousand fissures, through all the meshes of this interior region, flow the waters of the plateau,

sometimes by the vent of Rochemale, and sometimes, and only when rains are abundant and when the vent is not sufficient for its task, by the river Midroï, constituting affluents to the Ardèche of a special order, many examples of which are known in rivers of the type of the Ardèche and the Tarn.—*Translated for the Popular Science Monthly from La Nature.*

OUR SOUTHERN MOCKER.

By I. W. BLAKE.

THE American mocking bird (*Mimus polyglottos*), although native to a country which claims to be democratic in principle, is by nature pure and simple a born aristocrat. It is true that at first sight he may be a disappointment to any one anticipating a bird of brilliant color; but the more one studies the mocker the more strengthened becomes the opinion that few birds, if any, can aspire to his dainty, high-bred personality, or to his slender grace and elegance of movement. Indeed, to this unconscious, inborn "Delsartean" ease, poise, and lightness, as well as to his marvelous power of imitation, the mocker owes his attractiveness; for this sleek fellow in his sober coat of gray—tipped with black, and lightened only by a glimpse of white when he spreads his wings—can lay no claim to beauty of feather as an additional charm to win him admiration. The plumage allotted him by Nature serves merely as a background, so to speak, which shall not distract the eye while his listeners pause in wonder as he fills the clear air with his marvelous melody.

The bird lover at the North, who sees the mocker caged, gloomy and despondent or restlessly beating himself against the merciless bars of his prison, knows nothing of the real power of the bird until he hears him singing at full liberty in the brilliant sunshine of his native heath, for the variations in the song of the mocker depend largely upon his surroundings. Thus, in a city he quickly acquires loud, sharp, and unpleasant notes; while in the country, where incessant barn-yard music reigns supreme, he soon adapts himself to his position. Take him, however, free, happy, saucy fellow that he is in the South, in localities where he hears few sounds but the voices of clear-throated birds, and his song is naturally mellow and sweet, standing unsurpassed in its wonderful modulations and gradations, compass, and brilliancy of execution. The mocker seems instinctively to select the prettiest quirks and quavers he can gather from his neighbors. Many of the sweetest notes in his *répertoire* he acquires from the red or cardinal bird, which has certain liquid, flutelike whistles, all of which our little

imitator quickly appropriates, without even the grace of an acknowledgment.

The mocking bird, like all aristocrats, has no humility in his "make-up," and at times this disposition makes him most exasperatingly overbearing—as, for instance, when choice fruit is slowly ripening and the contest begins, to ascertain whether the landowner or Monsieur Mockey shall collect the harvest! Firmly believing himself to be lord of all, the premises resound with the queer, fierce scoldings which he bestows upon all usurpers, and our little gray-coated songster shows a pugnaciousness that is surprising. The sound of a mocker's scolding resembles the sudden splitting of long strips of heavy silk, and, as he has a habit of leaving his voice all along the path behind him as he flies angrily away, fretting and disputing at every step, the sound is so fierce, so long drawn out, and so far extending, that one involuntarily sniffs the air for the sulphurous odor which should, by right, accompany so savage a train of ugliness.

The housekeeping and family cares of a pair of mockers are wearing to themselves and to the entire neighborhood, and attractive as the bird may be in his adult years, as *enfant terrible*, in all the agonies of the preparatory and freshman year, he is a nuisance of the most tiresome type. As soon as the little ones are coaxed from the nest for their first outing the trouble begins, and the exertion necessary to find sufficient food to fill those never-satisfied, gasping, shrieking throats reduces both parent birds to gaunt and peevish little gray ghosts before the month is out. Indeed, the very sight of this practical, unpoetical side of real life would make many a student of the much-discussed question, "Is marriage a failure?" pause and cry out mentally, "Blessed be single bliss!"

After some four or five weeks of tribulation, these baby mockers—such as escape the sharp beak of the murderous shrike or butcher bird—enter the sophomore class, instinctively assume tall hats, and begin to feed themselves. In spite of the annoyance of their tiresome shrill piping, almost incessant from dawn until sunset, silent only from necessity when their throats are being stuffed with the hard-earned food, they are a funny sight as they sit perched in a row upon a fence-rail, with their tiny feathers fluffed out until the little fellows resemble soft, gray puffballs. There, occasionally flying to some neighboring low-growing shrub for a change, with wings fluttering unceasingly and with heads thrown back to give greater voice room, they will sit for hours, their shrieks arising to squeals of indescribable ecstasy when the old birds approach with the coveted worm. Should a cat chance to stray into their neighborhood, it is very comical to see them all shake, or rather shudder, their tiny wings violently, as they alter

their food call to a harsh *scrawing* sound, thus calling the parent birds back to the rescue.

Putting aside the family question, the mocking bird is, of course, the prettiest and most attractive when the instinct of mating is predominant. As each pair build usually three or four nests, and rear from four to five young at each nesting, one may have many opportunities to witness their courtship methods. The prettiest sight of all is the courtship dance, which should be seen to be appreciated, owing to the deep solemnity and apparent earnestness of the birds. Imagine a large chessboard laid out in chalk lines; make it, say, a yard square; then place the birds thereon, diagonally opposite to each other, one at each extreme corner. The plan of the dance seems to be that they shall hop, or rather bound, slowly from one end to the other, always in a straight line, and not for any one moment to stand directly facing each other, except at the instant of passing.

With bodies stiff and straight as an arrow, head erect and feathers flattened, wings drooping loosely forward, but tails elevated at as acute an angle to the body as possible, the dance solemnly begins. The eyes are steadily fixed, and as methodically as any soldiers upon drill they sturdily go through the movement of bounding, rising quite high and descending in very nearly the same place each time, from one end of the playground to the other, back and forth, always keeping the line about a foot apart. As each one nears his or her corner, each slowly and dignifiedly turns a complete circle, then again faces the other, always diagonally, and slowly bounds back, to repeat the movement at the other end. Sometimes both will turn away to look off at some distant object, just as a cat will apparently forget the mouse she is tormenting. That, however, seems to be only a part of the ceremony, for soon both turn back and the dance is resumed.

One day I chanced to witness one of these pretty sights as it took place beneath the wide-spreading branches of a large orange tree, but the scene was interrupted quite unexpectedly. Just at the most graceful part of an intricate double pirouette, a very puffy and motherly old hen who, with an unlimited number of offspring, had been serenely picking up a dinner close by, evidently felt a sudden impatience at the sight of all this folly, for to my surprise and amusement she made a quick rush and dashed between these happy mockers, startling them almost out of their senses. Instantly the atmosphere was permeated with two separate and distinct streams of silk-splitting fire, each fully a rod long, as the two angry birds departed for the protection of a neighboring lemon tree.

The mocking bird instinctively selects a high perch from which to deliver his song, and the bare boughs of a dead pine tree, or

the topmost, ever-swaying branch of an orange or lemon tree, he finds well suited to his taste. He is a pretty sight when in some similar position, steadfastly facing the strong ocean wind which tosses his soft gray feathers in breezy fashion, he carols his sweetest to some half-indifferent *inamorata* not far distant. His little, slender body quivers with excitement in his efforts to drown the song of some stout-lunged rival, who sits gayly perched upon the gilded vane that surmounts the house top; now stopping short in the very middle of a note to hear if that other fellow has discovered his new combinations, and then, as he finds to his dismay that the rascal has them already down to a very fine point (with the addition of several new and surprising twists of his own), starting off again at a tearing pace with a bewildering variety of kinks, quirks, and quavers!

Soon darkness comes upon the scene—for twilight is short in the sunny South—and our musical mocker has sought his snug feather bed in the tree tops; but, by midnight, should the moon chance to be in her full glory of semitropical splendor, the hated memory of that unconquered rival stirs his little brain, and he awakens to pour out his pent-up jealousy in notes that make the welkin ring. The longer he sings the more ecstatic he grows, and after a few sleepy attempts to keep up with the torrent of music, the rival ignominiously subsides, and our little hero has the field to himself, undisputed, till the dawn of another day.

SKETCH OF JAMES BLYTHE ROGERS.

SCIENCE has need of all manner of men among its votaries. He whose career will be traced in this memoir devoted to its service a warm sympathy, an inspiring utterance, a high degree of constructive faculty, and a conscientiousness which caused him ever to give his best efforts to the duty before him.

JAMES BLYTHE ROGERS was born in Philadelphia, February 11, 1802, being the first child of Hannah (Blythe) and Patrick Kerr Rogers. His grandfather, Robert Rogers, was one of the gentry of County Tyrone, Ireland. At the age of twenty-one he married Sarah Kerr, daughter of a gentleman living near, whose family, like his own, were adherents of the Presbyterian Church. Mr. Rogers was owner of the Edergole or Knockbrack estate, lying between Omagh and Fintano, forty miles from Londonderry, and held on lease a piece of land adjoining it. Dr. W. S. W. Ruschenberger, whose excellent memoir on The Brothers Rogers * is the chief available source of information concerning this family,

* Proceedings of the American Philosophical Society, vol. xxiii, pp. 104–146.

mentions as additional evidence of his social standing that he inherited the large central pew in the neighboring Presbyterian church, which he rebuilt and furnished anew when the church was reconstructed. Robert Rogers was twice married; his first wife bore him twelve children, and the second five. Patrick Kerr Rogers was his eldest child. "The rudiments of Patrick's education," says Dr. Ruschenberger, "were received in a school-house built upon the estate. It is described as having clay walls, a thatched roof, clay seats covered with bits of carpet, and being warmed by a turf fire. The teacher was a lame rustic boy, whom Patrick's aunt, Margaret Rogers, a lady of notable intelligence, had trained for the office. It is conjectured that he acquired his classical learning from a private tutor at the house of a kinsman." The father of Sarah Kerr evidently did not believe in the law of primogeniture, for he had exacted, as a condition of his daughter's marriage to Robert Rogers, a settlement of all the latter's lands upon the children of this union, share and share alike. Accordingly, Patrick, although the eldest child, could expect only one twelfth of his father's landed estate, and must prepare himself for some other occupation than that of a landlord. "Entertaining opinions not rigidly orthodox, he was unwilling to enter the clerical profession, though he had the example of two uncles who were clergymen." All things considered, a commercial career seemed best, and he therefore entered a counting house in Dublin. When the Irish rebellion broke out, in the spring of 1798, he contributed to Dublin newspapers certain articles inimical to the Government, on account of which he was obliged to leave the country. At that period ships plied directly between Ireland and Philadelphia, and on one of these he embarked, landing at his destination in August, after a passage of eighty-four days.

In the following May Mr. Rogers obtained an appointment as a tutor in the University of Pennsylvania, and soon afterward began to study medicine under the famous Dr. Benjamin S. Barton. Mr. Rogers was married January 2, 1801, his wife being the youngest of the three orphan daughters of a Scotch father and an English mother. Their father, James Blythe, had been a stationer and newspaper publisher in Londonderry, whither he had gone from Glasgow. After the death of both parents the three sisters had come to America, where they were received by a cousin, Mrs. Thomas Moore. At the time of his marriage Mr. Rogers was described as "a tall, erect man, of grave deportment, having dark hair well sprinkled with gray, and soft, sleepy eyes. He played the violin and sang well, but never in company or in the presence of strangers, because such performance or display seemed to him inconsistent with the dignity of a gentleman."

After receiving his medical degree from the University of Pennsylvania, in June, 1802, Dr. Rogers began the practice of his profession in Philadelphia. He also took private pupils and lectured to classes in botany, chemistry, and other sciences. He was called to Ireland in 1803 to settle the estate of his father, who died in that year. This business disposed of, he returned to Philadelphia, bringing with him two brothers and a sister.

The next five years of effort did not bring him a satisfactory income and he removed to Baltimore, where he was more prosperous until he became involved in a controversy on methods of vaccination, which injured his practice. When Dr. Robert Hare resigned the professorship of Natural Philosophy and Mathematics in the ancient College of William and Mary, at Williamsburg, Va., Dr. Rogers was elected to succeed him. In this congenial position he remained, a competent and forceful instructor, until he died of malarial fever in 1828. His wife had succumbed to the same disease eight years before.

James B. Rogers received his elementary education in Baltimore during the residence of his parents in that city, and, after attending the College of William and Mary, took up the study of medicine in the office of Dr. Thomas E. Bond. In 1822 he received the degree of Doctor of Medicine from the University of Maryland. It is said that while a student he assisted his brothers William and Henry in teaching their school at Baltimore. After graduating he taught for a time a class of girls in conjunction with a Dr. McClellan, of Baltimore. This enterprise, proving unsatisfactory, was given up. Being now in need of employment, he thought of seeking the post of surgeon to a colony of free negroes which it was proposed to establish at Cape Mesurado. He consulted his father on this matter, and must have written a rather querulous letter, for he got this chunk of paternal hard sense in reply: "What is the use of your complaining of mankind? The world as yet owes you nothing. Up to this time you have been simply a recipient of its benefits. Make yourself worthy of a place *here* and you will find one." The project of going to Africa was abandoned.

Dr. Rogers now joined an intimate friend and fellow-student, Dr. Henry Webster, in a partnership to practice medicine at Little Britain, Pa., about two miles north of the Maryland line. But after a few years' experience he abandoned the profession, having found it repugnant to his mental habits and sensitive nature. He returned to Baltimore, and was soon appointed superintendent of the extensive chemical manufactory of Messrs. Tyson and Ellicott.

From this time on Dr. Rogers made pure and applied chemistry his chief concern. The professorship of Chemistry in the

Washington Medical College being offered to him, he hesitated to accept it, thinking he was not sufficiently ready of speech for a lecturer. He finally undertook the work, and, although it was not remunerative, it served to discover the fact that he shared the gift of eloquence which distinguished his brothers. The ice being thus broken, he found it easy to give chemical lectures before the Mechanics' Institute, in Baltimore, and later he lectured also on physics.

Dr. Joseph Carson states in his memoir of Dr. Rogers that it was William B. Rogers who induced his brother to venture upon the career of a college lecturer, and thus relates how it was accomplished: "To convince him that he had nothing to apprehend on that score [lack of fluency], his brother William prevailed upon him to accompany him to the lecture room, and there, placing the future professor behind the desk, constituted himself the audience. The theme was named, which being instantly taken up and amplified upon, the ease and fullness with which he spoke relieved him of his diffidence and apprehension. This was his first effort to lecture, and, like this, all his future performances were without notes or facilities of recollection, except those incident to the arrangement of the topic."

In September, 1830, being then twenty-eight years of age, he married Rachel Smith, of Baltimore, a birthright member of the Society of Friends.

Cincinnati was the residence of Dr. J. B. Rogers from 1835 to 1839, this period being the whole term of existence of the Medical Department of Cincinnati College, in which he had accepted the professorship of Chemistry. The summer vacations of these four years he spent as an assistant to his brother William in fieldwork and chemical investigations on the Geological Survey of Virginia. While in Cincinnati he declined the office of melter and refiner in the branch mint at New Orleans, offered to him by the President of the United States.

Dr. Rogers now, 1840, removed to Philadelphia and became an assistant to his brother Henry, who was the State Geologist of Pennsylvania. He also turned his knowledge of chemistry to account in various other occupations. He was appointed in 1841 lecturer on chemistry in the Philadelphia Medical Institute, then a flourishing summer school, which had been founded by Dr. Nathaniel Chapman. From 1844 to 1847 he was Professor of General Chemistry in the Franklin Institute, of which institution he had become a member when he went to live in Philadelphia. In this period he and his brother Robert compiled a text-book on Chemistry from the Inorganic Chemistry of Dr. Edward Turner and the Organic Chemistry of Dr. William Gregory. It was published in 1846. He also conducted quiz classes of medical stu-

dents. He was for a time Professor of Chemistry in the Franklin Medical College, and represented this institution in the National Medical Convention, held in Philadelphia in 1847, which organized the American Medical Association.

In 1847 he succeeded the celebrated Dr. Robert Hare as Professor of Chemistry in the University of Pennsylvania—a curious coincidence in connection with his father's succeeding Dr. Hare at Williamsburg. In this position he remained until his death, five years later. He was also one of the representatives of the university in the National Convention of 1850 for revising the Pharmacopœia of the United States.

In 1846 he was elected to membership in the American Philosophical Society, and the following year joined the Academy of Natural Sciences of Philadelphia.

Dr. Rogers was of slight frame and never enjoyed robust health. In his latter years he suffered at times from nervous exhaustion and defective nutrition, probably induced by unremitting labor. He died June 15, 1852, leaving a widow, two sons, William B. and Henry A., also a daughter, Mary V. Rogers.

Never favored by prosperity, Dr. Rogers was particularly straitened in circumstances during the first part of his residence in Philadelphia. It was not until he entered upon his last professorship that he received a comfortable salary. The institutions with which he had been connected before were small and weak or came to grief in some way that could not be anticipated. While lack of shrewdness and assertiveness on his own part may have contributed to hinder his advancement, his worth as a teacher is beyond question. He was everywhere esteemed by his colleagues and popular among his students. Dr. Carson said of him, "Disinterested and generous in his relations with the world, mild and conciliating in deportment, open and affable when approached, urbane to every one, his virtues shone conspicuously within the circle of his friends. With his pupils he was sympathizing; he entered cheerfully into their discouragements and difficulties; and those who confided to him received that encouragement and counsel so grateful to the student's feelings. He was emphatically the student's friend."

At the School of Horticulture, Geneva, Switzerland, fourteen professors are engaged in teaching the various branches of the science, which include floriculture, arboriculture, kitchen gardening, landscape architecture, forest culture, vine dressing, zoölogy, bee raising, botany, chemistry, and metallurgy. A considerable part of the school day is devoted to practical work under the direction of five superintendents.

Editor's Table.

INTELLIGENCE IN THE PUBLIC SERVICE.

A RECENT writer in one of the magazines quotes John Stuart Mill as speaking in one of his letters to the historian Motley of "the fatal belief of your public that anybody is fit for anything." The trouble to which Mill refers is one that dates a long way back. It is not correct to say that in this community or anywhere else the belief prevails that anybody is fit for *anything*. Nobody thinks that anybody is fit to repair his watch, or to fit him with spectacles, or to cut him out a suit of clothes. We all believe in special training and special qualifications when it comes to matters like these; but what democratic communities, from Athens downward, have refused to believe is that any special qualifications are required for the art of political government. It is to be observed that it is political government *only* that is regarded as so simple and trivial a thing. To manage a bank, a railroad, a hotel, is allowed on all hands to require great skill and experience combined with no inconsiderable equipment of moral character; but to step into the Presidency and fill the office satisfactorily does not, it has been expressly stated, call for anything more than commonplace endowments. A little more seems, as a general thing, to be required of members of the Cabinet; but, broadly speaking, Mr. Mill's dictum, if we confine it—as doubtless he meant it to be confined—to politics, is true, that in this country "anybody is considered fit for anything."

What is the source of this most preposterous opinion? It is difficult to give any answer but one: the self-interest and vanity of the populace: self interest, because the unqualified office-seeker does not like to think he might be barred from office by lack of competency; vanity, because the voter who feels a sense of proprietorship in the Government does not like to think that he himself or any person he might recommend is not "good enough" for any office in the Government. Of course, it has to be admitted—though somewhat grudgingly—that offices requiring technical knowledge in connection with this or that branch of science can not be filled by persons destitute of such knowledge; but it is always a consolation to think that the most ignorant citizen could acceptably fill some higher office in which he would have power to make the men of science step round.

Fortunately, there are laws operating even in the political world which to some extent antagonize false theories. It may be sound democratic doctrine that any citizen is fit for any office; but when it has come to filling the offices, in some mysterious way conspicuously unfit individuals have not infrequently been ruled out. No one, of course, would venture to say that they were ruled out for lack of intellectual qualification; but they have been ruled out all the same, and left to wonder how it was that their candidature was not successful. In a few cases conspicuously fit candidates have been selected, to the great advantage of the public interests concerned.

The strongest proof, however, that there is a certain tendency in things to nullify wrong theories is the prog-

ress which this country has made in the matter of civil-service reform, and this in the teeth of the strongest opposition which could be made in the interest of the old, unregenerate idea that all offices were on a level with the abilities of the first comer, provided only he had the necessary certificates of political service. A powerful New York journal thought at one time to sneer the reform out of existence; but, the more it sneered, the more the idea seemed to gain in strength, and the more firmly it rooted itself in our system of government. This would seem to prove that the citizens of this country, however they might outwardly countenance the notion that anybody was fit for anything, felt in their hearts that the doctrine was a false and fraudulent one. That is precisely what it was and is; and the falsehood and the fraud have in many ways cost this country dear. It needs perhaps a little experience of administrative work in order to appreciate fully the difference in efficiency between a man in whom experience is united to intelligence and seriousness of purpose, and who is thus enabled to put a stamp of thoroughness on all he does, and one of mediocre or inferior intelligence who simply thinks he is big enough for any office, and that one way of doing a thing is about as good as another. It is always at the expense of the public that the latter type of official practices his crude and ignorant methods; but in general, though the shoe is sure to pinch, it is difficult, if not impossible, for the public to tell just where they are pinched or where the responsibility rests. We may set it down, however, for an unmistakable fact that, in so far as governmental methods are marked by inefficiency and lack of intelligence, the origin of the trouble lies in the idea to which we referred at the outset, that "anybody is fit for anything." The man who employs a blacksmith as a dentist when more skilled assistance is available has only himself to thank if he suffers a few unnecessary pangs; and precisely so in the public service: if we put into office men who lack the essential qualifications for their positions, we must take what we can get and, if not be thankful, at least have the sense to place the responsibility upon the right shoulders—that is, upon our own.

DECIMAL COMPUTATION.

THE article from the pen of Mr. Herbert Spencer which we publish in this number will, we believe, open the eyes of many of our readers to the fact that whatever the advantages of the metric system of measurement now so widely used in Europe may be, there are very considerable objections to its introduction in countries where it has not yet been established. Mr. Spencer, as usual, states his case in a very comprehensive manner; and it would be difficult to add anything to the arguments he brings forward. He makes it very clear that the only valid claim that can be urged on behalf of the metric system is that, on account of its correspondence with the existing system of notation, values expressed therein admit of easier arithmetical treatment than values expressed according to other methods. He shows, however, that this is quite a limited advantage. Express your values in the metric or decimal system, and you can add or multiply them with great facility; but the difficulty lies in getting those particular fractional values expressed which we have most occasion to use in everyday life, and which it is the instinctive habit of our minds to deal with—such as thirds, fourths, sixths,

eighths. It is needless, however, to repeat here what is so fully stated in Mr. Spencer's article. He admits the great convenience of the decimal system for the expression of strictly scientific values, as in giving the results of chemical analysis. In this case no other system than one which expresses results to the minutest fraction would be of any avail. But he objects, that this ready applicability to scientific measurements, which has led scientific men to advocate its universal employment, is no advantage for purposes of trade, where easy divisibility is of the first importance. The question is whether it is or is not desirable to introduce standards of measurement which can only be subdivided decimally, and banish our present standards, which admit of more convenient subdivision into well-known and definite aliquot parts.

We quite agree with the writer that such a change as this should not be hastily made, and we think he has done well in marshaling the difficulties and disadvantages with which it would be attended. The standards of measurement which every nation possesses are part of its history, and their long survival is at least *prima facie* evidence of their utility and convenience. If we take the particular instance which the word "metric" itself suggests, it seems to us we are better off with such familiar and convenient measures as the yard, the foot, the inch, and the subdivisions of the latter into halves, quarters, eighths, sixteenths, etc., than we should be with the metre divided into centimetres and millimetres—that is, into hundredths and thousandths. What the subject wants, however, is discussion from every point of view. The question is one in regard to which no single interest should have a decisive voice; yet there is always danger, when a change is mooted, that it will be carried through the vigorous insistence of those who want it, and to whom, perhaps, it would be advantageous, and the lack of contrary effort on the part of a much larger number to whom it would not be beneficial but who are not sufficiently alive to their interest in the matter.

Mr. Spencer hints at a possible change to be made in our system of notation involving the use of two additional digits and making twelve instead of ten the basic multiple of progression. He does not expect it can be introduced for generations to come. That if introduced it would have the specific advantages he mentions can not be doubted; but we agree with him that the practical difficulties in the way of the change are enormous, and that we must be content to regard it rather as a shadowy possibility for the future than as a scheme offering any promise of early fruition.

THE PROVINCE OF SCIENCE.

Dr. Romanes's assertion* that "if a little knowledge of physiology and a little knowledge of psychology dispose men to atheism, a deeper knowledge of both and, still more, a deeper thought upon their relations to one another will lead men back to some form of religion," is sure of unquestioning welcome in certain quarters ; but the earnest seeker after truth will care little to hear that George John Romanes or Francis Bacon "thought thus," although he may care a great deal to learn what led these writers to their belief.

The question which thoughtful men will wish to ask Romanes is whether his "religion" has any more

* Mind and Motion and Monism. By the late George John Romanes. Longmans, Green & Co. 1895.

basis in science than his "atheism"; whether either of them finds any warrant in our knowledge of Nature; whether both may not be equally outside its limits. Most modern thinkers and writers on the principles of science agree in the declaration that the mind of man has not yet attained to knowledge of causes; that it has done no more than to discover a little of the *order* of Nature.

While we may, if we choose, call the series of *events* which make up this order a series of *effects*, nothing seems more certain than that we have not yet succeeded in passing over from them to any reality behind them ; that the reason why they occur in one order rather than another is a problem which is as yet absolutely unsolved.

Romanes quotes, with approval which all must share, Tyndall's declaration that "the passage from the physics of the brain to the corresponding facts of consciousness is unthinkable. Granted that a definite thought and a definite molecular action in the brain occur simultaneously, we do not possess the intellectual organ, nor apparently any rudiments of the organ, which would enable us to pass, by a process of reasoning, from the one phenomenon to the other. They appear together, but we do not know why." So far as our present knowledge of the powers of the human mind goes, we must agree with Romanes that Tyndall's assertion is most unquestionably true. Whether or not it is the whole truth is a different question, and we must ask whether we are any more able to pass from one physical event to another physical event, or from one mental event to another mental event, than we are able to pass from a physical to a mental event. Can we say of any of them anything more than that "they appear together, but that we do not know why"?

Romanes tells us that our questions about the nature of the relation between material changes and mental changes admit of only seven possible answers, all of which he enumerates, and four of which we quote: I. The mental changes may cause the material changes (spiritualism). II. The material changes may cause the mental changes (materialism). III. There may be no causation either way, because the association may be only a phenomenal association—the two apparently diverse classes of phenomena being really one and the same (monism). VII. Whether or not there be any causation either way, the association may be one which is necessarily beyond the power of the human mind to explain.

The aim of Romanes's book is to show that six of these seven hypotheses are untenable, and that, since only seven are possible, the seventh, No. III, must be the truth; although it is clear that, if the human mind has as yet discovered nothing but the *order* of Nature, and has not attained to knowledge of causes, there must be still another point of view. We may declare that we know nothing whatever about the matter; not even enough to warrant the assertion that it is necessarily beyond the power of the human mind to explain. Romanes holds that this way of looking at the subject does not deserve to be regarded as an hypothesis at all; but while it may not be an hypothesis, it may nevertheless be that still more stubborn thing, a fact. Those who agree that it is a fact will feel no more vital interest in Romanes's monism than in materialism or idealism or spiritualism, for they will perceive that all these attempts to reach reality by means of our present knowledge of Nature

are equally vain and premature; and they will also perceive that science gives no better warrant for the "religion" to which Romanes has been led than it gives for the "atheism" which he has outgrown. We hope his fascinating book will find many readers, for it will give them the pleasure which is found in all strong and vivid works of the imagination; although we refrain from detailed discussion of its ingenious arguments, for the reason that we are sure no thoughtful student can mistake it for a contribution to knowledge.

If certain enthusiastic students of Nature have been carried away into materialism by the triumphs which modern science has achieved through the use of the symbolism of matter and motion, they can not complain that there has been any lack of warning. The most profound and cautious thinkers of our century have never ceased to insist that our conceptions of matter and motion are nothing more than symbols; and that, so far as knowledge of any reality behind them is concerned, they might as well be called x and y. General recognition of this truth is now producing a reaction which seems, to these zealous believers, to drive them out of their materialism into some other system of philosophy; but before they rush from one extreme to another, they should ask themselves whether this revolution will bring them any nearer to the solid rock of certainty than they were before. No one who is familiar with the work of our greatest intellectual leaders can find anything novel in Romanes's declaration that "when we speak of matter in motion we do not at all know what it is that moves, nor do we know at all what it is that we mean by motion"; although we must ask the followers of Romanes whether we know anything more about the essence of mind than we know about the essence of matter, and whether we can say anything more of our mental changes than that "they appear together, but we do not know why."

Prof. Ostwald tells us in his address on "The Failure of Scientific Materialism"* that "every scientific thinker, from the mathematician to the practicing physician, would sum up his view, in answer to the question how he supposes the world is intrinsically constituted, by saying that the universe is composed of atoms in motion, and that the atoms and the forces acting between them are the ultimate realities of which individual phenomena consist." Whatever the German frame of mind may be, we are disposed to believe that many Englishmen and Americans, if asked "What are the ultimate realities of which individual phenomena consist?" would answer that they do not know. We believe there would be no difficulty in finding many eminent men of science who have refused to have anything more to do with materialism than to make use of its symbols, so far as they have proved useful. So long ago as 1868, Huxley tells us† that he *shares with some of the most thoughtful men with whom he is acquainted* the union of materialistic terminology with the repudiation of materialistic philosophy; that he individually is no materialist, but, on the contrary, believes materialism to involve grave philosophical error. Ostwald seems to have come, somewhat late in the day, to the point of view from which Huxley's most thoughtful acquaintances contemplated materialism in 1868; but, unlike Huxley, he proposes a substitute, and seeks to show that

* See translation in Popular Science Monthly for March, 1896.

† Collected Essays, I, iii, 155.

"the predicate of reality can be ascribed only to energy."

Since it is generally admitted that, whatever the unknown reality may be, our conception of energy is a projection into the external world of the feeling of resistance and effort which accompanies our own voluntary actions, the question whether "the predicate of reality can be ascribed to energy" leads us at once to the preliminary question whether volition is real or phenomenal. If the interminable discussion on the freedom of the will, which has exercised the most acute intellects of our race for many centuries, teaches anything, it teaches that science is not yet able to answer the question whether the "predicate of reality" is or is not to be ascribed to volition; and that, in the present state of our knowledge of Nature, Ostwald's substitute for materialism is no better and no worse than the system which he seeks to displace and supplant.

THOSE BLESSED X RAYS.

We were quite prepared for it, as we mentioned last month; so it was no surprise to us to read the following in The Herald and Presbyter of a recent date, the reference therein being to Röntgen's discovery: "For one thing, it corroborates, so far as any material experiment can, Paul's doctrine of the spiritual body as now existing in man. It proves, as far as any experiment can prove, that a truer body, a body of which the phenomenal body is but the clothing, may now reside within us, and which (*sic*) awaits the moment of its unclothing, which we call death, to set it free." We are further told in the same article that the discovery in question "makes clear to the unscientific mind what Stuart (*sic*) and Tait announced, that matter in one state has no power to exclude matter in another and more refined state," and that we must therefore now be prepared to believe "that two particles of matter can and do occupy the same space at the same time."

A very few remarks on this piece of special pleading must suffice on the present occasion.

1. "Paul's doctrine of the spiritual body." Why this doctrine should be called Paul's it is hard to understand, seeing that it is encountered in every quarter of the globe among nations and tribes of almost every grade of civilization. In the Odyssey Ulysses talks to the "spiritual body" of Achilles in the nether world, a body which was "set free" when the natural body of the hero was slain. It is difficult, therefore, to see why Paul rather than Homer should be mentioned as having his "doctrine" confirmed by the discovery of the X rays.

2. Paul's doctrine, however, was not that there *may be* a spiritual body within—but, after all, why *within* more than *without*?—the natural body, but that there *is* such a body; whereas Röntgen, according even to the writer we are quoting, only proves that there *may be* one. A thousand proofs, however, that a thing may be does not advance us one whit toward proving that it is. Moreover, Röntgen's discovery does not point any more in the direction of a spiritual body within our bodies than it does in the direction of a spiritual body within cats, or dogs, or sheep, or trees, or stones.

3. Strictly speaking, Röntgen's discovery proves nothing about bodies in general that has not been known for centuries. That light can pass through solid bodies even of great thickness and density has been the common experience of mankind ever since the first transparent substance was discovered. Röntgen has merely discovered that substances which are not penetrable by ordinary

light rays are penetrable by other rays produced by electrical discharges in a very attenuated gaseous medium. How we are to derive any confirmation of the existence of a spiritual body from the action of these rays which could not equally have been drawn from the action of ordinary light rays in traversing such dense substances as glass and various crystals, is a question which it would probably puzzle the Herald and Presbyter to answer.

4. As to the possibility of two particles of matter occupying the same space at the same time, any one who chooses to indulge that pleasing and profitable fancy can do so; but how it can help in the present emergency we do not see. Any difficulty which there may have been about admitting the doctrine of a spiritual body has not arisen in the least from our ordinary conceptions of matter, because we know perfectly well, and have known for so long that the memory of man runneth not to the contrary, that one form of matter may be permeated by another form—the metals by gases, for example—in varying volumes. The trouble has not been to find room for the spiritual body in the natural body, but to find something more than a mere assertion of its existence at all or anywhere. This, unfortunately, is a difficulty which some persons can not be brought to understand: give them leave to think that what they want to believe is not impossible, and presto, they consider it proved. We have no objection in the world to the theory, whether Paul's, or Homer's, or Plato's, of a spiritual body; but we do think it a little hard that because a laborious experimenter like Röntgen has brought to light a new property of radiant energy—while, like a well-trained man of science, he only affirms what he has been able to demonstrate—others should rush in and insist that, without being aware of it, he has bolstered up some doctrine of theirs for which not one scintilla of evidence can be given. As this kind of thing, however, evidently can not be helped, we can only hope, as we said before, that in some mysterious way it may serve a useful purpose. It is better, on the whole, that each successive advance of science should be acclaimed as a confirmation of orthodoxy than denounced as a new manifestation of impiety; and certainly better far the treatment given to Röntgen and his tubes and screens than that meted out to Galileo and his telescope.

Scientific Literature.

SPECIAL BOOKS.

The first volume of the Criminology Series was the result of a special research; the second has a broader and more philosophical scope.* Obviously the collection and choice of data lie at the base of any reasoning in criminology. Considerable attention has been paid to such data as anatomical, physiological, and psychological anomalies of criminals. These, Prof. *Ferri* is convinced, are of value almost solely with respect to born criminals. He makes five classes of criminals: criminal madmen, born

* Criminal Sociology. By Enrico Ferri. Pp. 284, 12mo. New York: D. Appleton & Co. Price $1.50.

criminals, criminals by contracted habits, occasional criminals, and criminals by passion. Those in the last three classes he deems largely the victims of circumstances. He looks to criminal statistics for considerable light on the sociological side of criminality, and finds as the most conspicuous general phenomenon that they exhibit "the steadiness of the gravest forms of crime side by side with the continuous increase of slighter offenses." At the same time there are yearly fluctuations in the several kinds of offenses corresponding to seasons of great or small harvests, excessive heat or cold, political or commercial disturbance, etc. On this correspondence of the amount of criminality to the environment Prof. Ferri bases his "law of criminal saturation," which contradicts Quetelet's dictum as to a regular budget of crime. From this law it follows that the penalties hitherto regarded as the best remedies for crime can not be effectual. Our author, therefore, recommends what may be called "penal substitutes," the aim of which would be to reduce the factors of crime. As ways in which society can be protected indirectly from aggression he instances such devices as the shifting of taxes which tempt to fraud, the adaptation of governments to the people they control, scientific means for the detection of crime, wise legislation in regard to marriage and inheritance, scientific education, and the abolition of unwholesome amusements. The latter half of the volume is of most popular interest, as it is devoted to practical reforms. Among the changes that Prof. Ferri advocates are the general use of the Scotch verdict of "Not proven" in cases where neither guilt nor innocence is established, indemnification for judicial errors, the direction of criminal trials, not to appraising the culpability of the prisoner for a particular act, but to ascertaining to what type of criminals he belongs, the abolition of the jury, except in the trial of crimes of the political and social order, the employment of various grades of segregation of the criminal with indeterminate sentences, the commitment of insane criminals to asylums, add the abolition of the death penalty. Many other allied topics are discussed incidentally. The above constitutes what Ferri regards as a defensive system of criminal administration which society should substitute for its present punitive system.

We have had a life of Agassiz as a man, we now have him placed before us both as a man and a scientist by one of his scientific associates and fellow-countrymen.* In telling the story of Agassiz's life Prof. *Marcou* has made use of materials collected from many sources, including much obtained from Agassiz's European friends and associates. All of Agassiz's letters that he inserts, some twenty-five or thirty, were written in French and stand in the original language. So also do Agassiz's presidential address on the ice age, delivered before the Helvetic Society, which fills nineteen pages of small type, and the six pages of extracts from De Charpentier's first paper on erratic bowlders, the author believing that all these documents would suffer too much by translation. Our author is not one of those who write eulogy and call it biography. He lets both the well rounded and the less rounded sides of his subject's character be seen. While not depicting him as a demigod, Prof. Marcou has credited Agassiz with talents sufficient to accomplish the labors on which his fame rests.

* Life, Letters, and Works of Louis Agassiz. By Jules Marcou. Two Volumes, 12mo. New York and London: Macmillan & Co. Price, $4.

"Agassiz was capricious in the extreme," he says, "very versatile, attracted easily by any new object or subject, and he had the faculty of almost completely forgetting works half done or only sketched. He lacked persistence and steadiness at work requiring long and difficult observations. . . . That something sternly practical mingled with Agassiz's habitual idealism was well proved by his museum. He did not carry it out entirely as he proposed to do at the start, but had he lived twenty years longer his ideal museum would have become a reality. . . . Notwithstanding these serious defects, it is impossible not to admire his great scientific intelligence, and not to recognize his immense scientific force. No one was such an able instigator of scientific researches. He had a magnetic power, and he used it constantly, whatever the subject to be investigated might be. His two principal passions in natural history were teaching and collecting specimens. As a teacher he was unrivaled and unique. . . . As to his other passion, that of collecting specimens and organizing museums, he was a man of wonderful resource." Agassiz's moral traits are also given with much fullness. Many of his characteristics were racial. As his biographer well says, "Agassiz's remarkable personality can not be properly understood without taking into account the strength of his French nature." The Anglo-Saxon reader especially should bear this in mind. Prof. Marcou does not hesitate to go into the various controversies to which Agassiz was a party and to apportion praise and blame according to his judgment. The function of a critic seems to be rather attractive to him, for he goes out of his way to point out defects in Mrs. Agassiz's life of her husband. The word "Works" in the title of this book refers to a list of Agassiz's works, reaching 425 titles, which is appended to Volume II. A list of biographical articles and volumes on Agassiz forms another appendix, and a list of portraits, medals, tablets, etc., still another. A profile portrait and several other illustrations are given.

Two series of books which promise to be very useful to the scientific horticulturist and agriculturist are being issued by the Macmillans. In the Gardencraft Series, we have already noticed The Horticulturist's Rule-book, by Prof. *L. H. Bailey*, and the second of the series, also by Prof. Bailey, is now before us.* Our author treats his subject both philosophically and practically. He first points out some of the causes of variation in plants, and shows that man is only rarely the direct means of originating varieties, but that his work consists in selecting and fixing those that he prefers. In treating of crossing, Prof. Bailey insists on a distinction between the cross proper—i. e., the product from a union of two varieties of the same species—and the hybrid, or product of a union between different species. He tells what benefits may be expected from crossing, and endeavors to prevent too great expectations from hybridizing. The practical portions of the volume are the third and fifth chapters. In the former are given fifteen rules which should govern the breeding of plant-crosses, with the reasons for them. Among these we find such maxims as the following: "Avoid striving after features which are antagonistic or foreign to the species or genus with which you are working." "Breed for one thing at a time." "Establish the ideal of the desired variety firmly in the mind

* Plant-breeding. By L. H. Bailey. Pp. 293, 12mo. London and New York: Macmillan & Co. Price, $1.

before any attempt is made at plant-breeding." "Even when the desired variety is obtained, it must be kept up to the standard by constant attention to selection." The last chapter consists of directions for the pollination of flowers to secure crossing, with illustrations. There are also extended extracts from Verlot on varieties of ornamental plants, Carrière on bud-varieties, and Focke on characteristics of crosses. A glossary is appended.

The Rural Science Series, edited by Prof. Bailey, opens with a volume on spraying.* From the author's chapter on the early history of liquid applications, it appears that plants have been sprinkled with noxious or irritating substances in order to destroy insects for a century, and very likely much longer. The operation known as spraying, however, has not been practiced for more than ten or fifteen years. The early gardeners seemed to think that anything disagreeable to man would be destructive to insects, and Mr. *Lodeman* gives a number of their recipes evidently based on this idea. Continuing his history, he narrates the introduction of the Bordeaux mixture, the kerosene emulsion, Paris green, London purple, and the other principal insecticides and fungicides now used, and gives the various methods of spraying employed in different countries and in different parts of the United States. Another historical chapter records the progress in appliances, from the liquid in a bucket and a whisk broom to sprinkle it with, up to the small towers on carts on the top of which men armed with hose pipes go gunning for codlin moths, curculios, cankerworms, and such like game. In another chapter he gives formulas for a large number of preparations used in spraying, and, in still another, specific directions for treating the chief cultivated plants, from almond to willow. He discusses also the action of insecticides and fungicides not only upon the pests that they are directed against, but also upon the host-plant, the crop yielded by it, and the soil in which it grows. There are eighty-six cuts and a portrait of M. Millardet, who introduced the Bordeaux mixture. Both volumes are adequately indexed.

We have here not the gossip and superficial impressions of a sight-seer, nor yet a volume of laborious measurements and close reasoning. *Greenland Icefields* is a description of natural features and inhabitants by one who is not too much engrossed in his science when he visits a strange region to notice and write down matters of interest to less scientific mortals.† With this descriptive matter is joined a new discussion of the causes of the ice age, embodied in several chapters contributed by Prof. *Upham.* Prof. *Wright* tells us first about the ice of the Labrador Current, which was brought forcibly to his attention by the steamer on which he went to Greenland running squarely against an iceberg. This mishap necessitated a stop on the coast of Labrador, and enabled him to gather may interesting observations on the settlements and the Eskimos of this coast. He records also some observations on the Spitzbergen ice that comes down through Davis Strait. Greenland was finally reached at Sukkertoppen, on the western coast, in latitude 65° 30′. Prof. Wright gives us not only the incidents of his journeys in this far northern land, but also the chief features

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* The Spraying of Plants. By E. G. Lodeman. Pp. 399, 12mo. London and New York: Macmillan & Co. Price, $1.

† Greenland Icefields and Life in the North Atlantic. By G. Frederick Wright and Warren Upham. Pp. 407, 12mo. New York: D. Appleton & Co. Price, $2.

of the twelve districts into which the western coast strip is divided, some account of the customs and character of the Eskimos, and a historical sketch of the explorations and administration of Europeans in Greenland. His descriptive matter is frequently enlivened by anecdotes, and the text is illustrated by reproductions of many photographic views of persons and places.

From materials furnished by Prof. Wright and other explorers, Prof. Upham has prepared descriptions of the plants and the animals of Greenland and of the inland ice sheet. He also devotes a chapter to tracing the continental changes of level of the Pleistocene period. With this material as a basis, he proceeds to discuss the causes of the ice age, giving the theories that have been put forth to account for the great extension of the ice, and explaining the difference of opinion among glacialists as to whether there were one or more epochs of glaciation. The authors of this book hold to the theory that the ice sheets were due to extensive uplifts of the land forming plateaus which received snow throughout the year. In another chapter the successive stages of the ice age are traced as revealed by their marginal moraines and other deposits. In conclusion, Prof. Wright summarizes the chief facts relating to Greenland's mantle of ice, and to the life of its inhabitants, who seem to be admirably adapted to their surroundings and happy in them.

GENERAL NOTICES.

Paleontology is presented from a point of view somewhat different from the ordinary in a book which Prof. *Williams*, of Yale University, has just published.* The author says that while there are no end of books on evolution, and modern biologists seem content to assume that some theory of evolution is true, and although the sociologist, the moralist, and the theologian are basing their theories about man on the "working hypothesis" of the naturalist, as if "law and gospel," it seems to have escaped serious attention that we have open for study a genuine record of the actual evolution of organisms, extending from near the beginning of life up to the present time. The geologist does not ask what is the theory of evolution, but what are the facts of evolution. The book is intended simply as an introduction to an already broad field, which is rapidly widening. The history of organisms is first taken up and treated quite fully. The next two chapters consist of a history of the making of the geological time scale, and a general consideration of its divisions. The naming and the fossils of stratified rocks, the nature of fossils and their geographical distribution next occupy attention. What is a species? What is an organism? and What is the origin of species? are the elementary but important questions answered in the next three chapters. The principles of natural history, classification, and the types of construction in the animal kingdom, occupy Chapters XI and XII. Phylogenesis in classification, the acquirement of characters of generic or higher rank, what is evolved in evolution, the modification of generic characters, and the plasticity and permanency of characters in the history of organisms, bring us to the eighteenth chapter, which takes up the cephalopods, to illustrate the rate of morphological differentiation in a genetic series. In Chapter XIX the ammonids are studied in a similar manner to illustrate the progressive modification of an extrinsic character. The last two chapters —one on the laws of evolution, as emphasized by a study of the geological history of organisms, and finally the philosophical conclusions regarding the causes determining the course of evolution, are in the nature of a general summary of the whole subject.

* Geological Biology: An Introduction to the Geological History of Organisms. By H. Slater Williams. New York: Henry Holt & Co. Pp. 392, 8vo. Price, $2.80.

A valuable series of archæological investigations is chronicled in a tasteful 8vo entitled *The Hill Caves of Yucatan.** The author, who is Curator of the Museum of American and Prehistoric Archæology at the University of Pennsylvania, had had his eye, so to speak, on the Central American hill caves for several years. The expedition was at last made possible by the munificence of Mr. J. W. Corwith, of Chicago, its purpose being to search for new evidence of man's antiquity in the caves of Central America. The party landed at Progreso, and rapidly made their way into the interior. The coralline and porous Mesozoic limestone of that part of Yucatan had not been upheaved or faulted, and, save for the waves of the hill ridges, lay as it was deposited. The caves were found to open vertically down into the ground like wells, the shaft having evidently been formed by the natural weathering down of a level rock surface until a hole in the roof of the cave was produced. These caves, of which a number were examined, were found in some cases to contain rude inscriptions on the walls, in all cases a large number of broken potsherds, and in the excavations conducted in the layers of rubbish which made up the floor of the caverns, charcoal and ashes, mixed with potsherds of many makes and some bones, but no arrowheads, spear points, or even flakes of hornstone. Some human bones scattered in the rubbish indicated that the old inhabitants of Yucatan practiced cannibalism. Taken as a whole, the antiquities show us the ancient cave visitor as an agriculturist rather than a hunter, although he seems not to have possessed domestic animals. The author, in closing, says: "An earlier people visiting Yucatan under its present topographical conditions must needs have left traces in the caves; because the undisturbed earth beneath the culture layer discovered always failed to show trace of any deeper, older, or more primitive human visitor, the conclusion was that no such earlier people had seen the region while its stony hills, its torrid plain, and its damp caves were as they now are." The book, aside from its archæological value, is of interest as giving a picture of the geography and people of that portion of Yucatan. It is very well illustrated.

* The Hill Caves of Yucatan. By Henry C. Mercer. Philadelphia: J. B. Lippincott Co. Pp. 183. Price, $2.

One of the most beneficent services rendered by modern science consists in supplying a basis of exact knowledge for those necessary arts that have been carried on by empiric methods for centuries. Among the most ancient of these arts is that of utilizing the milk of our flocks and herds, for which a scientific basis has only recently become available. It is the purpose of the book before us * to give the chemistry and bacteriology of the several processes of the dairy. The author first describes briefly the cow's udder and its process of secretion, and then passes to the composition of milk, giving the percentage composition of the milk of a number of animals, with a discussion of the variations observed, and a table of the legal standards in England and many of the United States. After setting forth some of the causes that influence the yield and quality of milk, he passes to the subject on which science has been able to give the most practical knowledge to the dairyman—bacteria. It is bacteria that cause milk to become ropy or viscous to turn blue, red, or yellow, to acquire a bitter taste, and to undergo fermentative curdling. Bacteria also are indispensable in the making of butter and cheese. Pure cultures of these organisms are used in dairies all over the north of Europe for ripening cream, and our author urges his fellow-countrymen not to be behind the foreigner in this matter. After discussing the essential features of the formation of butter and cheese, including the process of churning and the action of rennet, he gives the usual modes of testing milk, and closes with a chapter on milk as a food.

Convinced that throughout Europe there must have existed systems of picture writing such as survive among primitive races, Mr. *Arthur J. Evans*, the keeper of the Ashmolean Museum, has made extended explorations in Crete which have brought to light

* Milk: its Nature and Composition. By C. M. Aikman. Pp. 180, 12mo. London: Adam & Charles Black. New York: Macmillan & Co. Price, $1.25.

not only a large number of carvings of apparent pictographic character, but also many simpler markings which seem to show the existence of a system of linear writing, more ancient than that of the Phœnicians. In a volume entitled *Cretan Pictographs and Præ-Phœnician Script* (London: Quaritch; New York: Putnams) he has described a large number of these carvings, together with others from the sepulchral deposit near Phæstos, in the Peloponnese. The work is illustrated with one hundred and thirty-nine figures and several plates, including a reconstruction of a Mycenean ceiling decoration in colors.

A very practical and without doubt a unique book is the *Laboratory Manual of Inorganic Preparations*, of *H. T. Vulté* and *George M. S. Neustadt* (Peck, $2). It tells the student how to prepare a large number of the inorganic reagents used in the laboratory, the processes ranging in difficulty from the distilling of water and the preparing of oxygen and hydrogen gases to the preparation of hydrazine, carbon oxysulphide, and acid or alkaline normal solutions. The number of substances included is, apparently, over two hundred. In the recovery of substances that have been used in experiments and in the preparation of C. P. reagents from chemicals of commercial grade the authors are convinced that not only can much needless waste be prevented, but that much knowledge of value to the student can be acquired.

Of two recent numbers of *The Journal of the College of Science* of the Japanese Imperial University, one, being Volume VIII, Part II, contains five papers relating to biological subjects, accompanied by nine plates; and the other, Volume IX, Part I, comprises ten physical and chemical papers, with five plates.

In his monograph on *The Physical Geography of Southern New England* (American Book Co., 20 cents), Prof. *William M. Davis* presents evidence to show that the region in question is an old peneplain which has had a slanting uplift. In accordance with this theory, he accounts for the mountains that stand out from or rise above the New England upland and for the valleys that interrupt it. The paper contains many suggestions for the genuine scientific teaching of geography. The physiographic development of *The Southern Appalachians* is set forth in a similar essay by *C. W. Hayes*. Both publications are numbers of the first volume of National Geographic Monographs.

Under the title *The Climatology and Physical Features of Maryland*, the Maryland State Weather Service has issued its first biennial report, covering the years 1892 and 1893. The document includes sketches of the topography and geology of the State and general descriptions of its soils and climate. Monthly summaries of the weather and a summary of the weekly weather crop bulletins issued during these two years are included, while in tabular form the reports of observers are given. There are five maps, showing the annual and seasonal temperature and precipitation in Maryland and Delaware.

A quarto pamphlet of *Observation Blanks in Physics*, prepared by Prof. *William C. A. Hammel*, has been issued recently (American Book Co., 30 cents). These blanks contain directions for fifty-four simple experiments relating to air, liquids, and heat, with blank lines for observation, inference, name, date, instructor's indorsement, etc. There are also figures of the parts of the apparatus required, many of the articles being household utensils.

We have already called attention to the series of pamphlet guides to New England natural history which is being issued by *Edward Knobel*. The one now before us is devoted to *The Night Moths of New England* (Whidden, 50 cents), and gives the name, size, and colors of five hundred species with figures of nearly all of them. The species are arranged in seven groups, each with a brief key, and there are three pages of general description.

There is substantial evidence that science is not neglected on the Pacific coast in the eight-hundred-page volume of *Proceedings of the California Academy of Sciences*, which constitutes Part I of Volume V of this publication. Among the more extended monographs which it contains are a Review of the Reptiles of Lower California, by John Van Denburgh; California Water Birds, by Leverett M. Loomis; Neocene Stratigraphy of

the Santa Cruz Mountains, by George H. Ashley; Fishes of Sinaloa, by David Starr Jordan; and Contributions to Western Botany, by Marcus E. Jones. Entomology, conchology, zoölogy, and paleontology are also represented. The volume is accompanied by a frontispiece and seventy-four other plates.

The fourteenth volume of *Transactions of the New York Academy of Sciences* testifies to considerable activity during the year 1894–'95. This volume contains papers on geological subjects by Arthur Hollick, J. F. Kemp, G. F. Matthew, W. D. Matthew, and Heinrich Ries; on biological subjects by Gary N. Calkins, Harrison G. Dyar, and George S. Huntington; while chemistry is represented by Bohuslav Brauner, botany by N. L. Britton and T. H. Kearny, Jr., astronomy by Herman S. Davis and J. K. Rees, mineralogy by G. F. Kunz, and physics by R. A. Millikan. Forty-nine plates accompany these papers. A considerable number of papers that were read during the season either appear elsewhere or have not been published.

Again *Wurtz's Elements of Modern Chemistry* comes to us in a revised (the fifth American) edition (Lippincott, $1.80). Dr. *Greene*, the translator, has associated Dr. *H. F. Keller* with himself in this revision and enlargement, which is designed to bring the book thoroughly up to date. The volume now consists of 808 duodecimo pages, and contains 136 cuts.

Bulletin No. 119 of the U. S. Geological Survey is *A Geological Reconnoissance in Northwest Wyoming*, by *George H. Eldridge* (Geological Survey, 10 cents). It gives a sketch of the topography and general geology of the region, and points out the chief features of its economic geology. First among its useful minerals is a fair quality of coal; petroleum, building stone, brick clays, and a small quantity of gold are also found.

In a treatise entitled *The Constitution and Functions of Gases, the Nature of Radiance, and the Law of Radiation*, the author, *Severinus J. Corrigan*, gives a technical presentation of his theory of gases, the basal concept of which is that the atoms of which each molecule of gas is composed revolve about the center of the molecule. He holds that his theory enables him to demonstrate the existence of some heretofore unknown properties and functions of gases, to determine the probable nature and the properties of the luminiferous ether and the effective temperature of the sun, and to indicate the probable origin of all thermal, electric, and magnetic forces. (Printed by the Pioneer Press, St. Paul.)

A problem which is receiving increasing attention of late years, namely, what to read, is considered by *W. M. Griswold* in *A Descriptive List of Books for the Young* (the author, Cambridge, Mass.). Biography, Geography, History, Exploration, Natural History, Poetry and Fiction, Amusements and Occupations, and Literature are the chapter headings. "Natural Science" is disposed of in one page, seven works being recommended. Considering the broad field which this title is usually supposed to cover, the treatment seems a trifle inadequate. That branch of knowledge which has produced the steam engine, the electric light, the telephone, the phonograph, the printing press, modern astronomy, and chemistry, which is supplying material every day tending toward solutions of some of the still numerous unsolved problems of existence—in fact, which is the great motive force behind modern civilization—ought certainly to be represented by more than one page in a list that gives thirty-three pages to fiction.

Among the many desirable winter resorts which are readily accessible to the inhabitant of the eastern United States, there is perhaps none in which more natural beauty and historic interest are combined with an equable temperature than the Windward Islands. It was on one of them that Columbus first set foot in the New World, and since then they have had a most varied and unique history. In a little book of descriptive travel, *Cruising among the Caribbees* (Scribners, $1.50), *Charles A. Stoddard*, of the New York Observer, has given an attractive and interesting account of a winter visit to this curious little group. A general description of each island, both as regards topography, industries, and inhabitants, is given "in the rough." Various queer customs and superstitions and bits of myth and folklore are recounted, and the whole is woven in with

anecdote and history in such a skillful way that a hero and heroine seem all that is lacking to make of it a good bit of fiction.

The so-called science of phrenology is set forth at considerable length in a book by *Nelson Sizer*, entitled *How to Study Strangers* (Fowler & Wells, New York). It is a curious hodgepodge of very doubtful inferences clothed in scientific language. The body of the work is made up of portraits and short biographical and descriptive sketches of notable persons, written from the phrenologist's standpoint.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Delaware College: The San José Scale Insect.—Illinois University: Bulletin No. 41. Experiments with Wheat and Oats. Bulletin No. 42. Corn Experiments.—Massachusetts College: Bulletin No. 35. The Agricultural Value of Bone Meal. Bulletin No. 36. Imported Elm-leaf Beetles; Maple Pseudococcus; Abbot Sphinx; San José Scale.—Michigan State College: Fruits at South Haven and at the Agricultural College.—Ohio Station (Wooster): Oats.—Purdue University: Bacteriosis of Carnations; The American Persimmon.—United States Department: The Army Worm; The Carpet Beetle or "Buffalo Moth"; Canker Worms; The Imported Elm-leaf Beetle; Facts and Figures regarding Our Forest Resources Briefly Stated; Forest Fire Legislation in the United States; Work against Insects which Defoliate Shade Trees in Cities and Towns; The Harlequin Cabbage Bug or Calico-back; The Hessian Fly; The Hop-plant Louse; Condensed Information concerning some of the more Important Insecticides; The American Cotton-boll Weevil; Mosquitoes and Fleas; The Pear-tree Psylla; The Rose Chafer; The San José Scale.

American Humane Association. Abstract of Report on Vivisection. Pp. 16.

American Republics, Annual Report of Director of Bureau of, 1895. Pp. 28.

American Society for Prevention of Cruelty to Animals. Thirteenth Annual Report. Pp. 118.

Bulletins, Catalogues, Reports, Reprints, etc. Arthur, J. C. Delayed Germination of Cocklebur. Pp. 9.—Bell, A. G. Growth of the Oral Method of Instructing the Deaf. Pp. 23.—College Catalogues and Announcements. Colorado College: Studies, Vol. VI. Cornell: Announcement of Course of Instruction in the Summer School for Teachers and Advanced Students, July 6 to August 15, 1896. Lafayette: Catalogue, 1895–'96. Lehigh: Courses in Civil Engineering and General Literature. Massachusetts Institute of Technology: Catalogue, 1895–'96, and Annual Report of the President and Treasurer, December 11, 1895. Michigan Mining School: Annual Report of the Director, August 16, 1895. University of Pennsylvania: Circular of Information and Announcements for 1896–'97.—Fowler, Hon. Charles N. Speech on the Free Coinage of Silver.—Gilbert, G. K. Presidential Address before Geological Society of Washington, 1895.—Hodge, F. W. Pueblo Snake Ceremonials.—Home Study. A Monthly Elementary Journal of Engineering. 15 cents; $1.50.—Howard, L. O. The Grass and Grain Joint Worm Flies and their Allies. (Technical Series No 2, United States Department of Agriculture.) Pp. 24—Johns Hopkins University: Circular, Vol. XV, No. 123. Pp. 10.—Labor, Bulletin of Department of. No. 3. March, 1896. Pp. 111.—MacDougal, D. T. A Contribution to the Physiology of the Root Tubers of Isopyrum Biternatum (Raf.), Torr. and Gray. From Minnesota Botanical Studies.—Nashville, Tenn., Board of Health. Twenty-first Annual Report of Health Officer to, for Year ending December 31, 1895.—New Jersey Geological Survey. Report on Forestry. Pp. 88.—Philadelphia Academy of Natural Sciences, Proceedings of. Pp. 105 to 200.—St. Laurent, C. F. Germanization and Americanization compared. Pp. 20.—University of the State of New York. Bulletin of the New York State Museum, September, 1895.—Ward, Lester F. Sociology and Physiology. (From American Journal of Sociology, March, 1896.)—White, C. A. Memoir of George Engelmann, M. D. (From vol. iv, Biographical Memoirs National Academy of Sciences.)—Woolman, A. J. Report upon Ichthyological Investigations in Western Minnesota and Eastern North Dakota. From Report of United States Commission of Fish and Fisheries for 1893.

Carus, Dr. Paul. The Religion of Science. Chicago: The Open Court Publishing Co. Pp. 125. 50 cents.

Chester, Albert Huntington. A Dictionary of the Names of Minerals, including their History and Etymology. New York: John Wiley & Sons. London: Chapman & Hall, Limited. Pp. 320.

Comey, Arthur Messinger. A Dictionary of Chemical Solubilities (Inorganic). New York and London: Macmillan & Co. Pp. 515. $5.

Cope, E. D., Ph. D. The Primary Factors of Organic Evolution. Chicago: The Open Court Publishing Co. Pp. 547. $2.

Fisher, J. H. Hypnotism and its Relation to Witchcraft, Ghostology, and Mind Cure. Grand Rapids: Seymour & Muir Printing Co. Pp. 83.

Halleck, R. P. Psychology and Psychic Culture. New York: American Book Co. Pp. 368. $1.25.

Hart, Ernest. Hypnotism, Mesmerism, and the New Witchcraft. New and Enlarged Edition. New York: D. Appleton & Co. Pp. 212. $1.50.

James, William. Is Life worth Living? Philadelphia: S. Burns Weston. Pp. 63.

Knauff, Theodore C. A Dissatisfied Farmer. Philadelphia: The Sound Money League. Pp. 45.

Le Plongeon, Augustus, M. D. Queen Moó and the Egyptian Sphinx. New York: Author. Pp. 277.

Mosso, Angelo. Fear. Translated by E. Lough and F. Kiesow. New York and London: Longmans, Green & Co. Pp. 278.

Nye, Bill. Bill Nye's Sparks. Pp. 181.—Nye and Riley's Wit and Humor. Pp. 203. Chicago: F. Tennyson Neely.

Ribot, Th. The Psychology of Attention. Chicago: The Open Court Publishing Co. Pp. 120. 75 cents.

Romanes, George John. An Examination of Weismannism. Chicago: Open Court Publishing Co. Pp. 209. 35 cents.

Schoenhof, J. A History of Money and Prices. New York and London: G. P. Putnam's Sons. Pp. 352. $1.50.

Tyndall, John. The Glaciers of the Alps. New Edition. New York and London: Longmans, Green & Co. Pp. 445. $2.50.

White, Andrew D. A History of the Warfare of Science with Theology in Christendom. Two vols. New York: D. Appleton & Co. Pp. 889. $5.

Fragments of Science.

Some New Observations on Underground Temperatures.—Some recent observations on underground temperatures are described in the December number of the American Journal of Science by Prof. A. Agassiz. He says: "For several years past I have, with the assistance of Mr. Preston C. F. West, been making rock temperature observations as we increased the depth at which the mining operations of the Calumet and Hecla Mining Company were carried on. We have now attained at our deepest point a vertical depth of 4,712 feet, and have taken temperatures of the rock at 105 feet; at the depth of the level of Lake Superior, 655 feet; at that of the level of the sea, 1,257 feet; at that of the deepest part of Lake Superior, 1,663 feet; and at four additional stations, each respectively 550, 550, 561, and 1,256 feet below the preceding one, the deepest point at which temperatures have been taken being 4,580 feet. We propose when we have reached our final depth, 4,900 feet, to take an additional rock temperature, and to then publish in full the details of our observations. In the meantime it may be interesting to give the results as they stand. The highest rock temperature obtained at the depth of 4,580 feet was 79° F.; the rock temperature at the depth of 105 feet was 59° F. Taking that as the depth unaffected by local temperature variations, we have a column of 4,475 feet of rock with a difference of temperature of 20° F., or an average increase of 1° F. for 223·7 feet. This is very different from any recorded observations, Lord Kelvin, if I am not mistaken, giving as the increase for 1° F., fifty-one feet, while the observations based on the temperature observations of the St. Gothard Tunnel gave an increase of 1° F. for sixty feet. The calculations based upon the latter observations gave an approximate thickness of the crust of the earth in one case of about twenty miles, in the other twenty-six. Taking our observations, the crust would be over eighty miles, and the thickness of the crust at the critical temperature of water would be over thirty-one miles, instead of about seven and 8·5 miles as by the other and older ratios. . . . The holes in which we placed slow registering Negretti and Zambra thermometers were drilled, slightly inclined upward, to a depth of ten feet from the face of the rock and plugged with wood and clay. In these holes the thermometers were left from one to three months. The average annual temperature of the air is 48° F.; the temperature of the air at the bottom of the shaft was 72° F." A possible source of error in these observations arises from the free access which the surface air has to the mine, and the probable effect which it must exercise on the rock temperature for many feet about it. This is, of course, also true of the previous observations, conducted in mines or tunnels. Another feature which would perhaps introduce a source of error is the close proximity of the enormous mass of water in Lake Superior. It seems probable that the rock temperature in this whole region is largely modified by the vast body of water in the lake system.

The Northern Appalachians.—A concise, satisfactory summary of the characteristics of the northern Appalachian Mountain ranges is given by Mr. Bailey Willis in a paper published in the series of Monographs of the National Geographic Society. Instead of being marked by a central crest, as is usually the case, these ranges are characterized by a central zone, the surface of which is lower than the ranges on either side. This zone is a very complex valley, or series of valleys, and is known by different names in different sections of its length of a thousand miles. Two principal ranges bound it—one on the southeast, generally known as the Blue Ridge, and the other on the northwest, known as the Alleghany Front. They extend in two nearly parallel lines about seventy-five miles apart, and have each its special characteristics. The rivers flow either to the Atlantic or to the Ohio River. The divide between these groups of streams is winding and often inconspicuous, and has no definite relation to the

principal heights. The Delaware, Susquehanna, and Potomac rise west of the Alleghany Front, which they cross, and, continuing eastward, traverse the Alleghany ridges and the Blue Ridge to reach the Atlantic. From among the Alleghany ridges of Virginia the James and Roanoke flow through the Blue Ridge eastward. New River, on the contrary, has its source east of the Blue Ridge in North Carolina, and runs northwest across the Blue Ridge, the Alleghany ridges, and the Alleghany Front, to the Ohio. It is thus a general fact that the streams of the Appalachian ranges are not controlled by the mountains. The ridges pursue their courses, and the streams, passing across the ridges, pursue independent courses. The discordance is one of the most marked features in the topography, and it gives rise to many picturesque water gaps. It is due to the fact that the transverse river channels are older than the valley ridges. Within the valley the brooks and creeks have arranged themselves usually in systems of pairs. Flowing southwest, a brook meets its fellow running northeast, and together they turn southeast or northwest to traverse a ridge. In the valley beyond the ridge they are joined by a pair similar to their own courses before their union. Beyond a second ridge or a third, the growing creek may for a time flow northeast or southwest, but it will presently pass out by another water gap. Ultimately it falls into one of the great transverse rivers. This arrangement of parallel brooks which swell the volume of a creek generally flowing at right angles to their courses, resembles a vine from whose central system branches are trained on a trellis. Although most conspicuously developed in the Alleghanies, this trellis system of drainage is common in regions where beds of hard rock lie steeply inclined to the general surface. The parallel branches of the system are controlled by the parallel ridges between each two pairs. Thus it appears that the hard rocks have to this extent influenced the arrangement of the streams.

Petroleum-Lamp Accidents.—The recent report of Mr. Alfred Spencer, an officer of the control department of the London County Council, on petroleum-lamp accidents, and the measures necessary for preventing them, is a very important and practical document. His conclusions regarding their safe construction and proper management are as follows: (1) The oil reservoir should be of strong metal, properly folded and soldered at the joint, and should not be of china, glass, or other fragile material. (2) There should be no opening between the reservoir and the burner, other than through the tube which holds the wick, and this tube should be extended to within a quarter of an inch of the bottom of the reservoir, and should have no opening into the reservoir except at its base. (3) The burner should be securely attached to the reservoir, preferably by means of a strong and well-made screw attachment. (4) There should be no openings through which oil could flow from the reservoir should the lamp upset. (5) Every table lamp should have a broad and heavy base, to which the reservoir should be strongly attached. (6) Wicks should be soft and not tightly plaited, and should quite fill the wick-tube without having to be squeezed into it. (7) Wicks should be frequently renewed, and before being put into lamps should be dried at a fire and then immediately soaked with oil. (8) The reservoir should be filled with oil before the lamp is lit. (9) The lamp should be kept thoroughly clean, all oil should be carefully wiped off, and all charred wick and dirt removed, before lighting. (10) When first lit, the wick should be partially turned down, and then gradually raised. (11) The wick should not be left turned down, as there is then a greater liability to explosion in lamps of unsafe construction. (12) Lamps which have no extinguishing apparatus should be put out as follows: The wick should be turned down until there is only a small, flickering flame, and a sharp puff of breath should then be sent across the top of the chimney, but not down it. (13) Cans or bottles used for oil should be free from water and dirt, and should be kept thoroughly closed.

The Serum Treatment of Disease.—It is stated in the British Medical Journal that the serum treatment of disease probably originated in the observation made by Von Fodor, in 1887, that blood when drawn from the body had a distinct bactericidal action. "Nuttall and others then pointed out that

although this bacteriological action might be connected with the corpuscles of the blood, it was not confined to them, as the serum of freshly coagulated blood was found to contain some proteid substance which nndoubtedly exerted a powerful bactericidal effect. In July, 1889, Babes and Lepp recorded a number of experiments in which they had found that the blood of dogs which had been vaccinated against rabies exerted a distinctly protective action when injected into susceptible animals, either previous to or along with the virus procured from a rabid animal. Ferran appears to have been the next observer to accentuate this point. He was followed by Bouchard in France, while Behring and Kitasato in Germany, and then Roux in Paris, and others in rapid succession pointed out that there was in the serum of the blood of animals vaccinated against diphtheria and tetanus a distinct prophylactic and curative agent which, however, it was difficult to separate from the serum. In 1891 patients were treated in Berlin with a serum prepared by Behring, and since then this serum has been prepared and used in nearly all civilized countries."

Infected Drinking Water.—There is a growing tendency among physicians to belittle the purely chemical examination of potable water, and to rely solely upon the results of the bacteriological tests. A recent episode, the result of which seems at first sight to strengthen this view, occurred during the trials undertaken by the London Local Government Board, in which water samples, purposely inoculated with typhoid germs, were sent for analysis to one of England's leading chemists, and were by him pronounced pure. The obviously weak point in drawing such a conclusion from the above occurrence lies in the fact that such a sample of water would not be found in practice. The mere fact that it contained no sewage, to detect which is the chief purpose of the chemical analysis, would almost certainly in practice preclude the typhoid bacillus, the pure culture being only a laboratory product. The same is practically true with all the pathogenic micro-organisms which are liable to occur in drinking water. The chemical ingredients which the sewage supplies are quite essential for the rapid growth and multiplication of the bacteria. In fact, a favorable breeding ground is perhaps not second in importance to the presence of the germ itself, as the number of individual microbes, up to a certain point, which gain access to the human body, is probably of much more importance than the kind of germ. "The chemist," says Prof. W. P. Mason, in an article in the Journal of the American Chemical Society, "is unable to say whether or not a sewage-laden water is disease-bearing on any particular date, for to him all sewage is alike, but he condemns the water for the reason that, although it may be harmless to-day, it is impossible to predict what may be its condition to-morrow. Within the week I have been requested to make a bacteriological examination of the water of a certain well, in order to determine if it be affected by neighboring cesspools. The physician who made the request was impressed with the belief in the paramount value of such an examination and the comparative uselessness of chemical analysis. I am quite convinced that, had I followed his suggestions, I should have sought in vain for any specific microbe, but inasmuch as, upon chemical analysis, I found that the chlorine ran twenty-four parts per million, which is about ten times the local 'normal,' and the 'nitric nitrogen' read nine parts per million in place of 0·116, I condemned the water offhand without going further. . . . As Dr. Dupré has pointed out, chemistry in such cases anticipates what may happen in the future, and by timely advice may prevent an outbreak of disease; while, on the other hand, the discovery of disease germs in a water is only possible after the water has become infected."

A New Low-Temperature Apparatus.—A most interesting and important demonstration of the efficiency of the process of self-intensification of cold produced by expansion alone without the aid of any extraneous artificial refrigeration is described in a recent issue of Nature. The apparatus consisted of three coils of narrow copper tubing arranged concentrically in a metal case, and connected successively together. The gas, say oxygen, enters the outer coil at a pressure of one hundred and twenty atmospheres, passing from this into the second, and from

this into the central coil, which is surrounded by a cylindrical glass vacuum-jacketed vessel as devised by Prof. Dewar. The two outer coils are separated from each other by vertical divisions of the case, and the spiral of the central coil is followed by a flat spiral of sheet copper. When the gas reaches the extremity of the central coil, it escapes through a fine orifice of peculiar construction, formed by bringing two knife edges closely together. The size of the orifice can be regulated by means of an ebonite rod, which passes up the axis of the apparatus, and terminates in a handle at the top. After its escape the whole of the gas cooled by expansion passes through the spaces surrounding the pipe in which the compressed gas is passing to the point of expansion, and so makes this gas, still under pressure, cooler than it was itself while under compression. The compressed gas consequently becomes, at the point of expansion, cooler than that which preceded it, and in its turn follows backward the course of the still compressed gas, and so makes the latter cooler than before expansion, and also cooler than ever after expansion. This intensification of cooling (always assuming sufficient protection against access of heat from the outside) is only limited by the liquefaction of the gas, the temperature of liquefaction being in the case of oxygen 180° C. The apparatus exhibited measures twenty-eight inches deep by seven inches in diameter, and when once cooled down—that is, in about half an hour—it yields liquid oxygen at the rate of about seven cubic centimetres in four minutes.

How Opium is Prepared.—The English consul at Ispahan gives the following description of the process: The people commence to collect the drug early in May. The poppy head is lanced in the afternoon, and the opium which exudes and dries during the night is collected into copper pots early the following morning. It is kept in store in these pots until required for exportation. Then it is taken out of the pots and sorted. For the succeeding manipulations, each workman has a smooth board, about twenty-three inches long and eleven inches broad. He takes from the bulk about one pound of the crude opium, and rubs it on the board for a short time, then puts it in the sun for ten minutes, and afterward takes it into the shade and rubs it continuously with an iron implement something like a small solid spade, until it dries up to a certain degree. It is then collected into a mass and heated in trays over a small charcoal fire until plastic. Each man then takes about a quarter of a pound, and kneads it again on the board until it dries up to the standard degree and assumes a golden yellow color. It is next made up into cakes of one pound each, which are wrapped up in paper and placed in tin boxes, in layers alternating with poppy chaff. These tin boxes are packed in wooden ones covered with hide and gunny, and the opium is then ready for exportation.

The Finger-print Method of Identification.—In a recent letter to Nature, Kumagusu Minakata gives some interesting data, which seem to indicate that the ancient Japanese use of finger marks on divorce papers, as a means of identification, which the author described several years ago in the same periodical, was probably adopted from the Chinese Laws of Yung-Hwui, somewhere about 650 A. D. He has found a passage in the Arabian Relation des Voyages by one Sulaiman, who made several voyages to China and India in the middle of the ninth century A. D. (the time in which the above-mentioned dynasty in China was going to decline), describing the Chinese method of drawing up a contract: "The Chinese respect justice in their transactions and in judicial acts. If a man lends a sum of money to some one, he puts it down in writing. The borrower, in his turn, makes a similar writing, which he marks with two of his fingers together, the index and the middle finger. The two papers are put together and folded. Some characters are written across the portion where they join. They are then unfolded, and the writing by which the borrower acknowledges his debt is given to the lender. If, at a later time, the borrower denies his debt, he is told to bring the writing of the lender. If he pretends not to have it, and says he has never written a paper accompanied by his signature and his mark, and that his writing has been destroyed, they say to the borrower who denies his debt: 'Declare in writing that that debt

does not concern you. But if the creditor proves that which you deny, you will receive twenty blows on the back, and will pay an amend of twenty thousand (*fakoudj*) pieces of copper.'" The antiquity of this custom is of especial interest just at present, because of the rise into prominence of the so-called Bertillon system of identifying criminals, which is based on the finger-print method.

Solid Air.—In a recent address on The Liquefaction of Air and Research at Low Temperatures, before the Chemical Society, Prof. J. Dewar gave some very interesting descriptions of such unusual substances as "solid air" and "liquid hydrogen." He says: "If a litre of liquid air be exhausted in a silvered vacuum vessel, half a litre of solid air may be obtained and kept solid for half an hour. The solid is at first a stiff, transparent jelly, which, when placed in a magnetic field, has the still liquid oxygen drawn out to the poles, showing that solid air is a nitrogen jelly containing liquid oxygen; solid air can only be examined in a vacuum, or an atmosphere of hydrogen, because it instantly melts on exposure to the air, causing an additional quantity of air to liquefy. It is strange to see a mass of solid air melting in contact with the atmosphere, and all the time swelling up like a fountain. . . . A small ignited jet of hydrogen burns continuously below the surface of liquid oxygen, all the water produced being carried away as snow. . . . By means of a jet of liquid hydrogen, liquid air and oxygen were transformed into hard white solids resembling avalanche snow, quite different in appearance from the jellylike mass of solid air got by the use of the air pump." The only widely distributed element which has not yet been liquefied is fluorine.

Curious Verbal Customs in Madagascar.—A curious custom—said to be common throughout the country—of changing names and words, is described in J. T. Last's Notes on the Languages Spoken in Madagascar. The mention of the name borne by the king while living is tabooed after his decease, and violation of this law may be punished even with death. The name of a chief is tabooed to all in any way connected with him, and that of a notable person to all belonging to his family; and should there be another person in the family bearing the same name as that of the person deceased, that name must be laid aside and another one taken. This change of name is often made as a mark of respect for a friend. It is considered an honor to the dead man to change one's name. The author while traveling once heard some guns fired off in the distance-denoting death. He found, on inquiry, that the deceased was a grown-up daughter of a certain person; but the people were careful not to mention her name, because it was to be changed, and they did not yet know what new name would be adopted for her. The names given to deceased kings and chiefs are invariably formed of three words, of which the first is always *Andriana*—lord; the second some word denoting respect or honor, or pointing to some characteristic of the deceased; and the third and last, *arivo*—a thousand. Even among the common people it is considered highly indecorous to mention the name of a deceased person. Some special words are the exclusive prop, erty of kings and queens. Besides these, a number of words are common to kings and chiefs, but can not be used in the same manner by the other people. Again, the king has power to make certain words "fady," that is, to prohibit their use either for a time or entirely; and then other words must be adopted to be used in their place. Changes are often made in the use of words by the prohibition of words containing part of the name of the king or queen. These customs may be made to account for some of the differences existing between neighboring dialects; and their value as factors may be estimated when we consider the number of petty kings in Madagascar, and remember that the rules as to the name of each produce more or less permanent changes in the language.

The Deepest Sounding yet made.—It is stated that Captain Balfour, of H. M. S. Penguin, has obtained three soundings of over five thousand fathoms. They were taken in the Pacific Ocean at the following points: Latitude south, 23° 39°; longitude west, 175° 4′, 5,022 fathoms, at which point the wire broke; latitude south, 28° 44′; longitude west, 176° 4′, 5,147 fathoms; and

latitude south, 30° 28′; longitude west, 176° 39′, 5,155 fathoms (30,930 feet). The usual abysmal red clay was brought up by the sounding tube on the two latter occasions. Mr. V. Thorpe, surgeon of the Penguin, reports a microscopic examination of the specimen from 5,147 fathoms, which shows that the remains of siliceous organisms are almost if not entirely absent. The mineral particles are in a minute state of disintegration, and consist of exceedingly fine flocculent matter, mixed with pumice and other glassy volcanic products, green crystals of augite, and reddish crystals of pelagonite. The deepest trustworthy sounding previously made was 4,655 fathoms, obtained by U. S. S. Tuscarora near Japan in 1874.

Scientific Acquisitions from the Peary Expedition.—While adverse circumstances made it impossible for Lieutenant Peary to carry out, in full, his plans with reference to the northwest coast of Greenland, he, nevertheless, as Mr. Rollin D. Salisbury has shown in Science, accomplished much during his arctic residence. He twice crossed the ice cap from Inglefield Gulf to Independence Bay, and gathered information of singular value concerning the inland ice and the ice-free territory beyond. He mapped a considerable stretch of the coast from Cape Alexander to Cape York, or from latitude 78° 10′ to 75° 55′, covering eight degrees of longitude, and with indentations, prominences, and islands one thousand miles in length. This map includes so many features not given in the other maps that it is hard, at first sight, to recognize the identity of the regions. Eleven before unknown islands were accurately located, and the position, shape, and size of those heretofore represented were corrected. Possibly a hundred glaciers were located with approximate accuracy within a region where only ten were represented—not always correctly—on the published chart. Astrup's map of Melville Bay was prepared while its author was a member of Lieutenant Peary's company. A series of accurate and elaborate meteorological records was kept up, in which, besides the formal entries, observations were noted of the behavior of the winds about the ice sheet, presenting facts which may be of use in the study of the problems of glacierology. Measurements were made of the rate of motion of one of the most active glaciers of the region, and continued so long as to render them of special value. Two large meteorites were brought back for study. Lieutenant Peary enjoyed rare opportunities of personal contact and association, by living with them, for studying the Eskimos of north Greenland, and intends to publish the results of his studies. Much has been gained, further, through the expeditions which Lieutenant Peary caused to be sent into northern waters. Prof. L. L. Dyche, who joined the party in Greenland, secured valuable zoölogical collections of birds, walruses, reindeer, seals, and narwhals. Mr. Salisbury made observations and studies of the geographical and geological features of the west coast of Greenland, between latitudes 69° and 78° 45′, at close range from the vessel, and at numerous stopping places. Many glaciers were studied in detail, determinations respecting glacier motion were made, evidence was gathered touching the former extension of the ice cap of Greenland, and determinations were made concerning recent changes of level in the land.

Micronesia.—The following description is taken from a paper on the Marshall Islands, read before the Berlin Geographical Society on June 8, 1895: "The Marshall group consists of two nearly parallel series of islands, running from north-northwest to south-southeast, which are named by the natives *Ratak* (Islands toward the Dawn) and *Relik* (Islands toward the Sunset). The group covers about one hundred and seventy-six square miles. All are coral islands and most of them atolls. Of the *Relik* group the most important are Yaluit (the seat of government), Ebon, and Namvik. Of the *Ratak* group, Mejem has a population of about twelve hundred. The climate is, for a tropical region, comparatively favorable to Europeans. There are no swamps, but the continued high temperature and the moisture of the air render them dangerous for Europeans with heart or lung disease. Besides affections of the heart and kidneys, dysentery and rheumatism (both of the muscles and joints) are not uncommon. Observations extending over three years gave the mean temperature as 80·6° F., the extremes being 93° and 71°. The rainfall is

pretty evenly distributed throughout the year, and is quite excessive (one hundred and seventy-seven inches). It is only in January and February that a comparatively dry period can be expected. The northeast trades blow from December to April, becoming rather easterly or southeasterly from March to November. Calms or violent southwesterly storms occur chiefly between August and November. There being no springs, a supply of water is collected in tanks or cisterns. The useful plants include the cocoanut palm, bread-fruit tree, and *Pandanus odoratissimus*, the sap of which last is rich in sugar. The cultivation of plantains has much increased of late, besides which several kinds of arums, the South Sea arrowroot (*Tacca pinnatifida*), and a mangrove which supplies a black dye are grown. Guavas, figs, citrons, and anonas thrive well, but tea, coffee, cacao. etc., can not be grown at all. The Micronesian population amounts to from twelve thousand to thirteen thousand. The population belongs to four sharply defined classes. The great mass consists of the common people (*Kayur*); the next higher class is that of the *Leatakketak*, comparable to village magistrates, who see that the orders of the chiefs are carried out. Neither of these classes own land, but they are allowed to grow as much produce or catch as much fish as is necessary for their sustenance. The ordinary chiefs (*Burak*) rank above both these classes, and they often possess larger holdings than the head chiefs (*Iroj*). All the members of these four classes acquire their rank through the mother only. The race seems to be deteriorating physically, owing to the prevalence of specific disease, with which about fifty per cent of the inhabitants are afflicted."

MINOR PARAGRAPHS.

Anianus Jedlik died on the 12th of last December, at the cloister of the Benedictine order, in Gyor. He belonged to the old order of natural philosophers (he was born in 1800) who lacked that important portion of the latter-day physicists equipment, a knowledge of higher mathematics. Some of his more important treatises were under the following titles: The Deflection of Beams (1845); The Application of the Electro-magnet in Electro-dynamic Rotations (1856); A Modification of Grove and Bunsen's Battery (1857); The Magneto-motor (1857); Concatenation of Leyden Jars (1863); Electro-magnetic Undulation Machine (1868).

M. Abel Hovelacque, one of the most industrious and successful of the younger French students of anthropology, died in Paris, on the 22d of February, aged fifty-two years. His effective scientific career began in 1867, when, at the age of twenty-three years, he founded, with Chavée, the *Revue linguistique*, the first journal in France specially devoted to linguistics; joined the Anthropological Society, and began the publication of articles in various periodicals. These articles, largely relating to linguistic and cranial investigations, were followed by books on Our Ancestor; The Beginnings of Mankind; a Grammar of the Zend Language; an Elementary Linguistics; Languages, Races, and Nationalities; Observations on Herodotus and the Persians; The South Slavs; Linguistics; The Avesta, Zoroaster, and Mazdeism; and a lecture on the Evolution of Languages. On the foundation, by Broca, of the École d'Anthropologie, in 1876, Hovelacque was made Professor of Linguistic Ethnology. In 1890 he was made president of the school and chief director of the *Revue mensuelle de l'École d'Anthropologie.* He has also taken part with other anthropologists, whom M. André Lefevre speaks of collectively as a group, in other important enterprises and publications in anthropology.

La Revue Scientifique of December 14th contains an interesting anthropological note. It had been noticed that the wounds made by the arrows of the natives of New Hebrides were quite regularly followed by tetanus, and that the surrounding inhabitants were more afraid of these arrows than of a rifle bullet. A commission at Melbourne experimented on some animals, with these arrow points, in order to discover their poison, but obtained no results. So far as the animals were concerned, the arrows were not poisoned. A somewhat similar commission in 1883, authorized by the Governor of New Caledonia, gave no better results. In

preparing these arrows, the natives first cover the points with a mucilaginous compound, and then plunge them into the soil of crab burrows in some neighboring swamp. Hence it seems probable that years before our isolation of this virulent germ these savages were utilizing its fatal properties in their warfare.

NOTES.

Observations have been made by Prof. Lloyd Morgan on instinct in young birds with a view to determine how far the activities involved in swimming, diving, running, flying, feeding, bathing, etc., are instinctive or congenital, and how far the definiteness of this and other activities is a matter of individual acquisition. Other observations were on congenital and acquired timidity. They indicated that while the performance of the activities in question has a congenital basis, they are perfected by individual acquisition, and that there is no instinctive avoidance of insects with warning colors, this seeming to be entirely the result of individual experience. No material support was afforded to the view that the instinctive activities result from the inheritance of what is individually acquired.

Under the law of the State of New York the duty of analyzing artificial fertilizers and of prosecuting manufacturers of fraudulent goods is committed to the Agricultural Experiment Station at Geneva. Since May, 1894, prosecutions have been instituted in the case of eleven brands which fell materially below the guaranteed analyses. More than two thousand samples of commercial fertilizers have been collected and analyzed since July, 1890; and since October, 1890, thirteen fertilizer bulletins have been published, containing four hundred and twenty pages, of each of which about fifteen thousand copies have been distributed among the farmers of the State. The station has the addresses of one hundred and twenty firms doing business in fertilizers in this State, the goods of fifty-three of which are manufactured in other States. Its publications are sent free to all farmers in the State who ask for them.

The knowledge of sugar has been traced back away into the darkness of the past. The Chinese have been acquainted with it, according to the *Fortschritte der Industrie*, for more than three thousand years. From Asia, where it was extracted from a cane, it was brought into Greece by one of the generals of Alexander the Great, B. C. 325. In A. D. 150 it was prescribed by the doctor Galenus as a remedy for certain diseases. The refining of sugar was practiced in England about 1659. The story runs that the secret of sugar making was brought to Sicily by a Venetian merchant, who bought it from the Arabs for a hundred thousand crowns.

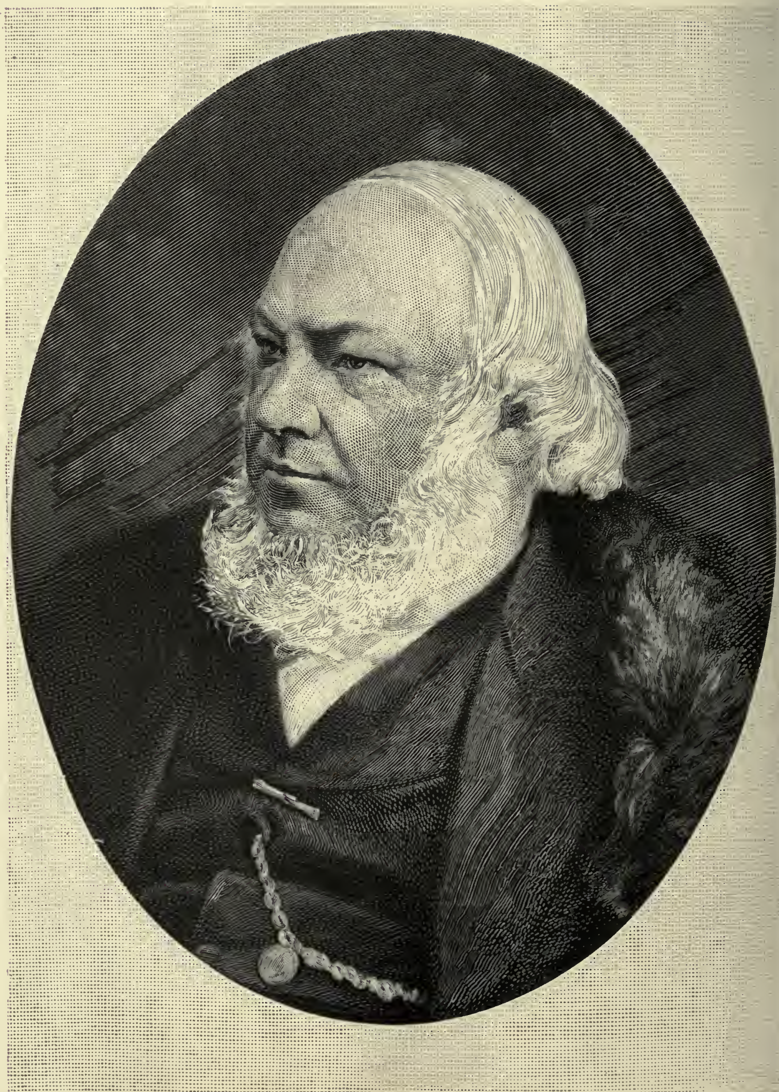
The number of metals found to be capable of combining with argon at a red heat is gradually increasing, and now includes magnesium, lithium, barium, aluminum, zinc, iron, and copper. Metallic barium has been found to absorb nitrogen rapidly, and its use as a cheap means of preparing argon from air has been suggested. Lithium absorbs nitrogen with incandescence at temperatures below a red heat; and it has been shown by M. Deslandres and M. Guntz that this absorption takes place slowly in the cold.

Among the scientific works announced for publication by Henry Holt & Co. are a book on Electricity, by Prof. Charles A. Perkins, of the University of Tennessee; A Problem Book in Elementary Chemistry, by E. Dana Pierce, of the Hotchkiss School, Lakeville, Conn., and the amusing *Preisgekrönt* of Eckstein, edited by Prof. Charles Bundy Wilson, of the University of Iowa, will shortly be added to the series of German texts published by this house.

In its issue for May 9th the Scientific American gives the particulars concerning an offer of a prize of two hundred and fifty dollars, which it makes for the best essay on The Progress of Invention during the Past Fifty Years received by June 20th. The prize essay will be published in the special fiftieth anniversary number of that journal on July 25th, and regular rates of compensation are offered for the five next best essays.

The institution of Arbor Day was started in Nebraska, in 1872, by the Hon. J. Sterling Morton, our present Secretary of Agriculture. The first efforts, as its history is told by Mr. B. O. Northrop, were not assuring; but its progress has been remarkable. The day is now observed in forty States and Territories of the United States, in Canada, and in certain districts of England, Australia, Japan, and South Africa. The Western settler who does not now plant trees is an exception; and the people of Nebraska, in particular, are proud of what they have achieved in this work.

The death-rate in the German army, which was 6·9 per thousand in 1870, was in 1894 only 2·4 per thousand. This decrease during the past twenty-five years in the death-rate in standing armies has been very general, and is accounted for by improved hygiene and sanitation. During the Franco-German War the French lost twenty-three thousand four hundred men from smallpox. The Germans, who had been strict vaccinators for thirty years, lost only three hundred men from this disease. The strictness of the vaccination law in the latter army may be gathered from the fact that since 1873 only two soldiers in this immense collection of men have died of smallpox.



JACOB MOLESCHOTT.

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PRINCIPLES OF TAXATION.

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II.—THE PLACE OF TAXATION IN LITERATURE AND HISTORY. PART VI.

THE TAX EXPERIENCES OF INDIA.—In contrast with the record of tax experiences in Egypt, that of India under like (British) influences, though equally singular and instructive, is not equally satisfactory. The elements of the problem of raising sufficient revenue to defray the expenses of the state since India passed under British rule and influence are substantially as follows:

A vast area of territory—1,609,151 square miles—with a population comprising more than one fifth of the human race—288,159,692 in 1891—and increasing at the rate of at least 30,000,000 for every decade, a number about equal to the present population of England and Wales; without homogeneity, but divided and subdivided, as is the case in no other country, by diversity of race, religion, caste, and language.*. Of the population of India, 217,000,000, according to the census of 1881, were unable to read or write; while as respects property, the testimony of recognized authorities in 1877 was, that the value of the total yield of the land of India from all sources, including the produce of mines and the

* In the Statistical Abstract relating to British India, annually published by the home Government, eighty-eight different languages, distinctively Asiatic or non-European, are recognized as characteristic of the population. In 1884–'85 out of a then total population of 253,891,536, only 202,920 were reported as using English in the sense of a mother-tongue; and only 1,862,626 that admitted of classification as "Christians."

annual value of manufactures, would not average more than forty shillings (ten dollars) per head for the entire population.* As compared with Egypt, the situation in India has this marked difference—namely, that whereas in the former country the extreme poverty of its rural population—the fellahs—has not been due to any lack of fertile land, or any incapacity on their part for obtaining from it a comfortable subsistence with continued betterments in condition, but owing to the fact that they have from time immemorial been deprived of the control of the fruits of their labors; while in India the population is increasing so rapidly—especially under the conditions of peace which have been attendant on British rule—and so disproportionately to the amount of new and fertile soil that can be appropriated, as to leave but little margin, under existing methods of cultivation, for increasing the means of subsistence for the people. In fact, the "Malthusian theory" is completely exemplifying itself in India, which is densely populated, destitute in a great degree of roads and of the knowledge and use of machinery.†

In a debate in the British House of Commons on the Indian budget, in August, 1894, Mr. S. Keay, an ex-official of the Indian Government, stated that in 1892 "he had a census taken of five villages in the presidency of Bombay. The population was 236. These five villages farmed 1,400 acres, the gross crop of which was valued at £193. If a starvation support of 14 shillings a year were allowed to each of the 236 persons and 11 shillings a year for each pair of bullocks kept to till the farm, the net produce of the five villages amounted to £5 for the year. Yet in the same year they paid to the inland revenue £73, and the village books showed that it was done by borrowing from the usurers at 24 per cent."

Mr. Keay further stated that "about seven years ago the Director-General of Statistics for all India published a book in which he stated that 40,000,000 of the people of India habitually went through life on an insufficiency of food. The Government of India wanted to be able to deny the statement, and they sent a con-

* Resources of Modern Commerce. A. J. Wilson. Longmans, London, 1878, vol. i, p. 57. Taxation in India. Shoshee Chunder Dutt, Justice of the Peace, Calcutta.

† Under the old-time system of native rulers, frequent wars, consequent on foreign invasions and internal race antagonisms, with accompanying famines and epidemic diseases, materially restricted the growth of the population of India. But under the conditions of peace that have been attendant during the last half century of British rule, the population of India has increased so rapidly that the limits of the agricultural capacity of the country, and the consequent means of subsistence for its people, seem to be approaching exhaustion; and one extraordinary drain upon the revenues of the Government in later years has been due to the wise creation of a national famine fund, to be used in cases of periodical emergencies due to failure of the crops, for the relief of multitudes who would otherwise perish by starvation.

fidential circular to the heads of departments and governors, in which they asked whether it was wholly or partially true, not that 40,000,000, but that the greater proportion of the population of India suffered from an insufficiency of food; and they directed that men of 'experience and judgment' should be set to make the inquiries. The replies were contained in five confidential Blue-books. In the district of Rampoor twelve scattered villages were taken, with a total population of 2,000. Of these, 1,600 were cultivators, and the remaining 400 were laborers, artisans, etc. It was found that, after deducting rent and the cost of cultivation, the cultivators had available for their support during the year sixteen rupees each, while the laborers had seventeen shillings a year each as the whole means of their subsistence. In another case it was shown that in a district having a population of over 1,000,000 souls, 173 persons had only thirteen shillings a year each to live upon. In another district the official reports which were contained in Blue-books marked 'confidential' showed that in a large district nearly all the inhabitants had to live upon from three eighths to three quarters of the amount of grain which was ascertained to be the *minimum* that would support a healthy condition of life."

In the debate that ensued, Sir Richard Temple, another ex-official of India, stated that "the calculations referred to by Mr. Keay were not worth the paper they were written on or the breath with which they were uttered. The data upon which they were founded were supposititious, and the deductions drawn from them were impossible. If they were true, the people of India would not be living at all, and the land would be of no market value. Yet, in another breath they were told that large sums of money were being advanced by local banks on security of the land."

Mr. Keay said that the facts and figures were quoted from the Blue-book.

Sir R. Temple retorted that "the facts were no facts at all. The tabular statements were merely tabular statements of particular theories of particular calculators. They were, in fact, delusions and snares. He preferred to take certain general facts which could be tested. He could not know or test how a particular family in India lived. He did, however, know the area of land under cultivation, the population of the country, the ratio of the increase in the population, the expansion of trade, and, above all, the exportation of foodstuffs. Honorable members told them that the people of India were starving, yet India exported food and grain stuffs to such an extent as to threaten disturbance to the markets of Europe, and particularly to disturb the markets of this country [England]. Honorable members told them that the people of India were sinking, yet the population had increased by

30,000,000 in ten years—a greater increase than in almost any other country. No doubt the taxable capacity was low, but he asserted that the people of India were, as to the poorer classes of the population, the lightest-taxed people in the world. The actual value of the produce of one man's land was difficult to test, but the rate of wages was easily ascertained. The poorest laboring man in India could, at the time when he was in India, earn Rs. 5 per month, and he would not pay more than Rs. 2 per annum in taxes.* A man here earning thirty-five pounds a year would not pay less than two pounds in taxation. This meant that in England the poor man paid one seventeenth, while in India the poor man paid only one thirtieth in taxes. Therefore the taxation of India was relatively much lower than in England. How could a people who were exporting such quantities of foodstuffs and who were increasing so greatly in population be said to be dying of starvation? In face of those facts, which could be proved, what weight was to be given by the House to amateur statisticians and their calculations? He had spent twenty-five years among the poorest people in India, and he had also spent fifteen years among the active life of the poorest people of this country. With that experience he asserted that the people of India were not so poor as the people of England." (London Times, August, 1894.)

It was evident, therefore, from the outset that the natural conditions of India were as antagonistic to the adoption of what may be termed the civilized forms of taxation, as they were to the adoption of the Christian religion or English habits and language; and the problem to the new rulers for obtaining revenue for the support of their Government, without resort to the old forms of arbitrary exactions or plunder, has accordingly always been one of great difficulty and delicacy; and the record of their experience in attempting to solve it constitutes an exceedingly novel and important chapter in economic history.

Practically the only guide to them for the determination and collection of taxes has been that of expediency. The imperial revenue of British India for 1893–'94, stated in *tens* of rupees, was £60,193,000, making no allowance for the depreciation of silver. The value of ten rupees is very nearly equivalent to the British pound sterling, or five dollars gold coin of the United States. The ordinary revenue of India for the fiscal year 1893–'94 was, therefore, about $300,968,000. The expenditures exceeded

* The value of the silver rupee—Rs.—in India at the time mentioned by Sir Richard Temple, expressed in terms of the United States gold dollar, was about $0.48 cents. Its present (1896) corresponding gold value is about $0.23.4 cents.

the receipts of revenue to the extent of about $30,000,000, and represented an annual deficit to that extent.*

The sources of revenue in India are mainly seven, but all of them, using the term in its ordinary signification, can not be characterized as "taxation."

The *first* and most important of them is the taxation of land, with which the Asiatic people have been familiar from a most remote period, and the justice of which is least questioned by them. In fact, reliance upon land revenue was a feature of the Indian governments long before England had any control over India. The native rulers maintained themselves for centuries by exacting shares of crops and cash contributions from cultivators of the soil. Taxation of land in India has therefore been retained, and not instituted by the present (British) Government. The entire land of India was nationalized centuries ago, and now as formerly (and as is the case in China) the primary title to all land inheres in the state or Government, and the cultivators of land pay a certain rent in respect to their tenancy.

There are two methods of land assessment in India, which involve a somewhat curious history. A hundred years ago, under the administration of Lord Cornwallis, an arrangement or treaty was made, which then and forever fixed the rate which the tenants of land in the government of Bengal—representing about one fourth of the present area of British India—should pay the state for their occupancy, and which then was regarded as a fair rental; and although since that arrangement was made, the land in question, owing to increased population, new industries, and state expenditures on roads and railroads, has greatly increased in value, and yields to the representatives of the primary lessees threefold or more rental, the British Government has to this day strictly respected its treaty and fulfilled its agreement. The fortunate controllers of the land thus rented—the *zemindars*, or native capitalists—having, however, improved their opportunities to oppress (rackrent) their subtenants, the Indian Government, since 1885, has undertaken to remedy this evil, and with a considerable degree of success. Land throughout India is divided into provinces, and the provinces themselves are divided and subdivided in such way that taxation in each locality is under the direction of an officer familiar with all the matters that must be taken into consideration in taxing justly. A multiplicity of

* "The gross revenue and the gross expenditure of India are very different things from the real revenue and real expenditure. In the gross revenue is included the entire receipts, and in the gross expenditure is included the entire expenditure of the whole railway system of India, the whole of the canal system, and of the irrigation works."—*Speech of Mr. H. Fowler, Secretary of State for India, introducing into Parliament the Budget for India, August 15, 1894.*

rights in the nature of land tenures are recognized in the assessments, and heed is also paid to the character of the lands and the purposes to which they are devoted. No increase of rent is ever allowed upon improvements made by the tenant himself, or upon improvements arising from the expenditure of public money; so that, in the opinion of those who have given personal attention and study to this subject, the English officials have finally established a land revenue system in India on a just basis.

The expense of collecting the land tax is heavy. In the so-called "village assessments" the collection is made by the local authorities. In other cases the large proprietors and notables pay the Government levies and recoup themselves by including their payments in the rents charged to their subtenants—the *ryots*, or peasantry. While the revenues from this source are very reliable, they are not regarded as capable of much further expansion. The gross receipts—imperial, provincial, and local—from the annual rental of tax on land in all India was officially returned for 1893–'94 at 25,589,600 Rx. (or about $123,000,000), representing an average rent or tax of $1.53 per acre. About nine tenths of the entire population of India belong to the agricultural class.

Second in order of importance of the sources of Indian revenue is the tax on salt, which, since its discontinuance in France in 1789, has ceased to be an excise or internal tax in European countries, with the exception of Italy, and which finds its warrant and justification at the present time in India in the fact, that apart from the land tax there is no other method so practical and economic of compelling the masses of its people to directly contribute anything for the support of the Government, inasmuch as the consumption of salt is a necessity for every individual. A very large proportion of the salt required for Indian consumption is imported—chiefly from England—and the total amount on which taxes are collected is about 500,000 tons, or 3,000,000 barrels. The rate of tax is two and a half silver rupees (nominally $1.00) per *maund* of 82·28 pounds. Previous to 1879–'80 the Government maintained, at great expense and popular annoyance, a customs line twenty-five hundred miles in length, to keep salt produced in the states under native rule from entering into British territory without the payment of a heavy duty. This barbarous system, necessitating the constant employment of a large force of native constables, known as *chuprassies*, invested with inquisitorial powers, was abolished at the time above named, by entering into treaties with the native states possessing salt sources, in virtue of which British officials are permitted to supervise their salt works and tax their product before it left them. But this could be only accomplished by paying the states concerned a satisfactory compensation for this con-

cession. The receipts of the imperial (Indian) revenue from the salt tax for 1894 were 8,228,000 Rx. (tens of rupees), or nominally about $41,000,000. The present average annual consumption of tax-paid salt by the people of India has been officially estimated at about ten and three fourths pounds per head, and the average annual burden of the tax on each Indian family of five persons at one rupee and a quarter, or *5d.* (ten cents); and in considering this tax it is desirable to bear in mind that there is no direct taxation in India either on tobacco or sugar, so that the salt tax is the only direct tax that the Indian peasant need pay, unless he indulges in alcohol or narcotics—the land assessment being regarded as in the nature of rent.

As the price of salt, by reason of the tax, is somewhat higher in India than in most other countries, the question as to its effect upon its population is one of high social and sanitary interest, in respect to which authorities differ. By some * it is contended that the consumption of this prime necessity is thereby greatly restricted, and that much disease, both of men and animals, is thereby engendered; and the trade in salt fish, which might supply a cheap and abundant article of food, is greatly hampered. Others assert that "the poorer classes do not feel aggrieved or complain about it"; that "as a rule the peasantry do not stint themselves on account of it"; and that "no one has ever taken exception to the tax as it stands but the European grievance-monger in the country." But, be this as it may, all are agreed that it would be very difficult to raise a revenue equivalent to that derived from the taxation of salt by any other method.

The *third* largest source of imperial revenue in India is from the Government monopoly of the production and sale of opium; and the annual receipts from which, although at one time in excess of $40,000,000, have of late years greatly diminished, and were officially reported in 1894 as 6,627,571 Rx. ($33,137,855). As the opium product of India is sold mainly to China and the Straits Settlements, and as the export taxes embodied in its price are collected from the people of these countries, they can not, therefore, be regarded as a fiscal burden upon the people of India.

The method of collecting the revenue from opium is substantially as follows: No person in British India may cultivate the poppy, from which the drug is derived, without a license from the Government; and every cultivator is bound to sell the crude product of his crop to the Government at certain factories, where it is manufactured into the opium of commerce. A portion of the manufactured opium is retained for consumption in India, and distributed through venders licensed by the excise depart-

* Wilson's Resources of Modern Commerce. London, Longmans, 1878.

ment. The remainder is sold monthly by auction to merchants, who export it; and on this exportation a duty is levied, from which the imperial revenue from this source mainly accrues. Opium produced in the native states of India pays the export duties when it passes into British territory. The Government prescribes rules for the cultivation of the poppy, and the manufacture, possession, transport, import (from native states) or export, and sale of opium; and any contravention of such rules is subject to stringent penalties. The product of the poppy illegally cultivated and opium made the subject of an offense against the law are liable to confiscation, together with the vessels and packages in which it is found and the animals and conveyances used in transporting it. Notwithstanding all these precautions, the price of opium consumed in the country—about one eleventh part of the whole—is more or less influenced by illicit supplies; so that the Government monopoly of this article is fully effective only in respect to the export trade. But even under such conditions, opium is the most valuable of all the native exports of India; and the annual value of the poppy crop, including the poppy seeds and the poppy oil produced from them (neither of which yield opium), or the annual money return, apart from the Government revenue, that the people of India get out of the crop, is estimated at about $70,000,000.

The *fourth* source in order of importance of the Indian revenue is from the so-called *excise*, which embraces licenses and distillery fees, licenses for the sale of liquors and drugs, and rent of "Toddy" trees—364,624 Rx. ($1,722,120) in 1894; duty on opium consumed in India—732,200 Rx. ($3,661,000) in 1894; fines, confiscations, and miscellaneous; total excise revenue for 1894, 5,388,573 Rx. ($26,942,865). The incidence of this form of taxation falls mainly upon Europeans and "Eurasians" (a modern name given to persons of mixed European and Indian blood). In this connection, the Imperial Secretary for India, in his budget speech (1894), stated that, "whereas in England there was a licensed shop to sell intoxicating liquors to every 106 of the population, in India there was only one for selling liquor and opium to every 2,148 of the population."

Fifth. The stamp system of taxation in India yielded a revenue in 1894 of 4,509,355 Rx., or $22,546,665. Although somewhat heavy in the aggregate, the system is not unpopular, for the reason that it is practically unknown to the mass of the people; the largest items of collection being returned, in 1894, under the heads of "court fee stamps" ($15,317,315) and "commercial and other stamps" ($5,841,995).

Sixth. "Provincial rates." Under this title are included a variety of levies, differing in name, character, and rate in differ-

ent places, and for the furtherance of special objects—as for paying the expenses of hospitals, schools, and police service; for the maintenance and construction of roads and irrigating facilities, the administration of wards' estates, and the like. The revenue reported from this source in 1894 was 3,514,571 Rx. ($17,572,855).

Seventh. Until within a very recent period (1894) the customs system of India—taxes on imports and exports—was one of the simplest in the world. No other country than the United Kingdom imposed duties on so few descriptions of merchandise—mainly on alcoholic liquors, salt, mineral oils, arms, ammunition, and a few special articles of food and drink. Export duties were also levied on rice and some other forms of grain. The aggregate receipts from customs fees, wharf rents, etc., in 1894, were 1,682,373 Rx. ($8,411,865). In March, 1894—the commencement of the Indian fiscal year—the Council of India, acting under the constraint of financial exigencies, imposed duties on almost all kinds of imports, cotton yarns and piece goods—constituting about one third in value of the entire imports by sea—excepted. Subsequently a uniform duty, equivalent to three and a half per cent *ad valorem*, was imposed on all imported cotton goods, and a corresponding excise tax on all the competing products of Indian mills—yarns and other cotton fabrics, the product of Indian hand labor, being exempted. "Except the weaving of fancy and highly elaborated clothing, which is largely conducted in and around Benares and in a few other districts, the handloom manufacture of cotton in India is mainly a spare-time industry, and is not professional."

Other important sources of internal revenue in India are the receipts from the sale of the products of the forests owned or managed by the Government—in the form of timber, firewood and charcoal, bamboos, sandalwood, grass, and other products—the total of which for 1894 was 1,723,022 Rx. ($8,615,110).

An annual tribute or contribution from a large number of native and mainly petty states of India toward the support of the Imperial Government was reported for 1894 at 774,337 Rx. ($3,871,685). On the other hand, the Imperial Government grants annual allowances, or pensions, to the native hereditary rulers of such states or their families, the aggregate of which for the fiscal year 1894 was 508,443 Rx. ($2,542,215).*

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* The British Government has respected the possessions of the native chiefs of India, and about one third of the country still nominally remains in the hands of its hereditary rulers. These, in return for their maintenance and protection by the Imperial Government of India, contribute annually from their resources a comparatively small sum for its support. The independent gross annual revenue of these so-called "feudatory" states is reported to amount to about £6,000,000 ($30,000,000), and their permanent military forces at "something like 300,000."

Income Tax.—The experience of the (British) Indian Government in attempting to raise revenue from the taxation of incomes, or by an income tax, is exceedingly interesting, and ought to be most instructive to the people of other countries. As a rule, the annual revenues of the Government of India do not and for a lengthened period have not equaled its annual expenditures, and the increase in the public debt of the country in recent years has accordingly been very considerable.* The major part of this debt, however, has been incurred for the construction of ordinary roads and railways, which in turn have not been unremunerative, and have made possible a large export sale of wheat and other commodities, which before their construction was impossible. The debt, or expenditures resulting in debt, has therefore contributed greatly to the welfare of the people of India. At the same time the demand and necessity for constantly increasing expenditures, continually confronts the Government with the most difficult problem of how to increase its revenue—a problem that very recently has been threatened with increasing embarrassment, owing to the position of not a few people in England, who, with more of sentiment than discretion or knowledge, have opposed the continuance of the present governmental monopoly of the production and sale of opium. A large increase of taxation in any form is regarded as not feasible in India; not so much because of an unwillingness on the part of the people to pay, for they are accustomed to pay all dues which they regard as fairly claimable by the sovereign power, and more especially when the demand is accompanied with control of force; but by reason of the extreme poverty and consequent actual inability of the masses of the people to pay. Experience has, moreover, shown that the natives of India are particularly opposed to all forms of direct taxation, other than on land, and more especially to taxes on houses, vehicles, and trades; and so extreme are their prejudices in this respect that any new levies of such character are only imposed by the Government with the greatest caution.

Something in the way of an income tax, exempting all incomes derived from agriculture, was probably imposed by some of the old-time native rulers of India. But the first attempt on the part of the British Legislative Council of India to revive such a form of direct taxation was made in 1860. What followed is thus forcibly set forth in a speech by Mr. Hope, before the Council, in January, 1886:

"Instead of a native model for direct taxation, softened and adapted to our circumstances, we unfortunately set up that of the

* For the year which closed on March 31, 1896, there was an estimated surplus of about 9,500,000 rupees.

income tax as it was in force in England. To get direct taxation into good working order, even after a suitable model, would have been a work of time and care, in the absence of any record of the names and resources of householders. But what, except failure, could attend a sudden call on relatively ignorant and unlettered millions, at short notice, to assess themselves, or prove right of exemption, to send in elaborate returns and calculations, and to understand and watch their own interests under the system of notices, surcharges, claims, abatements, installments, penalties, and what not, consequent thereon? Necessarily there followed a long train of evils. An army of tax assessors and collectors temporarily engaged could not be pure. They were aided by an army of informers, actuated by direct gain or private animosity. Frauds in assessment and collection went hand in hand with extortion in return for real or supposed exemption. Inquisition into private affairs, fabrication of false accounts where true ones did not exist or were inconvenient, acceptance of false returns, rejection of honest ones, unequal treatment of the similarly circumstanced—all these more or less prevailed. The tax reached numbers not really liable, for *zemindars* illegally recovered it from tenants and masters from servants, while underlings enriched themselves by the threat of a summons.

"Subsequent acts in 1862, while affording relief in some respects, practically stereotyped many inequalities and heartburnings. In later years, the system of assessment by broad classes was an improvement on the earlier complications, but the advance of local officers toward equitable assessment was perpetually being canceled by the alterations in rate and liability, which I next notice.

"Renewed direct taxation in British India thus made a false start, from which it has never recovered. Possibly, with time and care, a great improvement might have been effected, if the law had remained unaltered. But, unluckily, with its too English form came the idea that the tax was to be, as in England, a convenient means of rectifying budget inequalities, and a great reserve in every financial or national emergency. In consequence of this idea, incomes between Rs. 200 and Rs. 500, which had been taxed at two per cent in 1860 were exempted in 1862, the four-per-cent rate was reduced to three per cent in 1863, and the whole tax was dropped in 1865. In 1867 it reappeared in the modified form of a license tax, at the rate of only two per cent at most, but reaching down again to incomes of Rs. 200. In 1868 it became a certificate tax at rates a fifth lower, and again commencing with a Rs. 500 limit. In 1869 it became once more a full-blown income tax at one per cent on all incomes and profits of Rs. 500 and upward. In the middle of the same year it was suddenly nearly

doubled. In 1870 a further rise to fully three and an eighth per cent occurred; but with better times the rate fell in 1871 to one and one-twenty-fourth per cent, with a limit of Rs. 750, and in 1872 the limit was further relaxed to Rs. 1,000 and upward. In 1873 came a second period of total abolition, to be succeeded from 1877 to 1878 by the new series of acts. Along with the changes in rate and incidence just described came changes in name, form, classification, and procedure. With one object or another, twenty-three acts on the subject have been passed since 1860."

An income tax at a low rate, at present existing in India, grants an exemption of 500 rupees on all incomes, and exempts from taxation all income from the ownership of land or the sale of the products of land, and from property solely employed for religious or charitable purposes. It is thus assessable mainly on salaries, pensions, the income of companies, and of the ordinary trades and professions. Its existence is the cause of considerable friction with the officials who administer it, and constant appeals from their decisions are made from all parts of the country. In fact, this tax, at its present low rate, is universally detested, and the receipts from it are comparatively so inconsiderable—only 1,717,627 Rx. ($8,588,135) in 1894—that it may be regarded as a fiscal failure. Its whole experience in India furthermore reaffirms what is worthy of being regarded as an economic principle, namely, that when an income tax ceases to be regarded as generally oppressive it ceases also to be remunerative to the state.

One other point in this connection is especially worthy of notice. For a long period of years India has been characterized as a "sink-hole" of the precious metals, or, in other words, there has been for many years a continuous flow of the precious metals —gold and silver—into India, where they have to a large extent disappeared, undoubtedly by burial under ground for the purpose of hoarding and concealment. The motive for this under the Mogul and native rulers was unquestionably to escape direct plunder or confiscation; but under British rule these hoards, amounting unquestionably to many hundreds of millions, are not taxed, mainly by reason of their inaccessibility, and partly by the recognized policy of the Government to avoid direct taxation of active capital, and encourage, by making safe its employment, the tendency of these buried treasures to come to light and enter into the channels of trade. And that this policy has been a wise one is shown by the fact that within recent years there has been an increasing disposition on the part of the Indian owners of concealed treasures—especially the Indian princes or rajahs—to withdraw them from their hoarding places and invest them in Government bonds, or other desirable, interest-bearing securities; and in this way a very great addition to the world's active stock,

the money metals, may be anticipated in the perhaps not-distant future.

In the year 1893 the burden of taxation on the people of India, inclusive of the revenue derived from the rent of land, was officially estimated at two rupees and four annas, or nominally less than fifty cents per head; or, exclusive of the revenue from land, at about twenty-three cents per head—a rate relatively much lower than the taxation of England; so that, if the taxable ability of the people of India is low, the poorer classes of that country, it is claimed, are more lightly taxed than the poorer classes of Europe, or even of the United States. Before England assumed dominion in India the system of exaction of her native rulers was so perfected that they were assured of the very last penny that could be taken from the ryots, or peasantry, without stripping them of everything; leaving to the tenant class little more than the privilege of living. To-day the existing system of taxation in India is conceded to be at least eminently just. To-day it is generally admitted that there is no government in the world whose administration is more honestly conducted, and which is now doing more for the material good of the governed, than the present British Government of India. And herein is to be found the secret of England's success in ruling the vast congeries of people of different races, languages, and religions, known to us as India.

The consideration of another matter of recent occurrence and of the highest economic and social interest and importance, appropriately finds place in any discussion of the tax system of British India; more especially because it sets forth an attempt, founded on an unwarranted sentiment, indirectly to impose a large additional burden of taxation on the people of that country. As already pointed out, a present annual receipt of some $33,000,000 of revenue from the monopoly of the production and sale of opium, the incidence of which does not fall upon the Indian people, constitutes an important factor in this system. Acting on the assumption that the continued use of this drug, as a narcotic and stimulant, is in the highest degree injurious to the consumer—worse even than the continued use of alcohol—and especially demoralizing and destructive to the people of China, who are the purchasers and consumers of the major part of the opium product of India, a body of public opinion has in recent years grown up in Great Britain whose representatives hold that it was disgraceful and positively wicked for a people professing to be moral and enlightened to engage in or sanction the business of producing and supplying opium; and that it is the duty of their Government to at once interfere and put an end to it. And in recognition of this public opinion, and in deference to a numerously signed address to the Crown, the British Government, in

September, 1893, created a commission, consisting of nine eminently qualified persons, including two natives of India of high position and unconnected with the Government, and an eminent physician, to inquire into and fully report on this whole subject. The first report of the commission, published in 1894 and presenting simply the evidence taken in England, was an exhibit of the most interesting but utterly antagonistic and contradictory opinions and evidence. For the petitioners, sixteen witnesses, mainly missionaries, medical men connected with missions and residents for considerable periods in India and China, were called; and nearly all of these, as the result of personal experience and observation, testified in the most positive manner, and in consonance with popular opinion, that the use of opium physically, morally, and socially is highly deleterious, and ought to be discouraged, and if possible absolutely prevented. Considered by itself this testimony would seem to be conclusive and incapable of refutation. But, on the other hand, an equal number of witnesses—English officials, qualified by education, lengthened residence in India and China, and exceptional opportunities for observation, civil servants, medical men of the highest reputation connected with hospital and sanitary work and with the army in every part of India—gave unqualifiedly contradictory evidence, which may be summed up as follows: That opium has been used for centuries in India and China, without any extensive deleterious influence on the population; that the "Sikhs" of India, who in point of physical structure and health are claimed to be the finest people in the world, and whose religion forbids the use of tobacco, are habitual users of it; that while the excessive use of opium is unquestionably in a high degree deleterious, it is far less so than the excessive use of alcohol; that the use of opium in India and China is comparatively much less than the use of ardent spirits in Great Britain; that the excessive use of it, as by the so-called "opium sot," is the result very largely of the circumstance that the miserably poor afflicted with disease in India, China, and other Asiatic countries where there is no intelligent medical treatment, and little or no hospital service, resort to it as the only means of lessening their sufferings; that so far from the allegation being true that the supply of opium by India to China is disastrous in the highest degree to the people of the latter country, the fact is that the use of the Indian product, owing to its higher quality and price, is almost wholly restricted to the wealthier classes of China; that the cultivation of the poppy for the production of opium is very general in China, and to such an extent that one single province of the empire annually produces more opium than the entire export of India; and, finally, that any attempt on the part of either the Indian or Chinese Government

to interfere with the production and sale of opium, with a view of restricting or preventing its consumption, would be utterly futile, and in the case of the former country would undoubtedly lead to revolution.

One witness, Surgeon-General Sir William Moore, stated as the result of thirty-three years' service and observation in India, that opium-smoking is practically harmless, and opium water not only harmless, but beneficial in moderation, and a prophylactic against malarial fever.

The following circumstance was also regarded as substantiating this position: During the years 1893–'94 the island of Hong-Kong, on the Chinese coast, was ravaged by a pestilence, in the nature of a filth disease, of great malignity. Since its abatement it is claimed, with an accompanying array of evidence, that the opium smokers and eaters were almost without exception exempted from the pest.

Very naturally, also, the (British) Indian civil-service officials, holding the view that the large revenue derived by the Government from the monopoly of the production and sale of opium is in no sense a tax burden upon the Indian people; and recognizing also the great difficulty (but absolute necessity) of making good the deficiency consequent upon the abrogation of such revenue through new and additional taxation upon the people, were unanimously of the opinion that any change in the existing system in respect to opium would be in the highest degree inexpedient and unwarranted. When the question was put to Sir John Strachey, who in the course of thirty-eight years of Indian civil service has filled almost every post, from the most subordinate to the governorship of provinces and membership of the Government of India, how he accounted for the great contrariety of belief in respect to the opium question, he made answer as follows:

"The ignorance that prevails in this country [England] regarding everything Indian is enormous, and is not confined to those whom we expect to be ignorant, but extends to the most highly educated classes. It extends to all Indian subjects—history, geography, the conditions and habits of the people, the constitution of the Government—in fact, everything. I will give an illustration which always seems to me to have a useful bearing on this opium question. Mr. Buckle, in his History of Civilization, derives all the distinctive institutions of India and the peculiarities of its people from the fact, that the exclusive food of the natives of India is rice. It follows from this, he tells us, that caste prevails, that oppression is rife, that rents are high, and that customs and laws are stereotyped. I have no doubt that if Mr. Buckle had been asked, he would have said that the same cause accounted for the consumption of opium in India. I sometimes ask my English

friends, when they talk about opium, what they suppose to be the ordinary food of the people of India. The almost universal answer, perhaps with an air of displeasure that they should be asked such a foolish question, is that of course it is rice. I believe that nine tenths of the educated men and women of this country believe this to be true. When they have not learned such an elementary fact as this, that throughout the greater part of India rice is no more the ordinary food of the people than it is in England, how can we be surprised if they do not know the truth about opium? We who have spent our lives in India are not all fools or impostors. When I hear the Government of India charged with the abominable wickedness of poisoning its own subjects, and millions of Chinese also, for the sake of filthy lucre, there is only one reason that prevents me from being filled with indignation, and that is that I know that these charges are the offspring of ignorance alone. Unfortunately, this does not make them less serious, for, of all enemies to human progress, ignorance is the most formidable, and is especially formidable when, as in this present case, it is combined with honest enthusiasm and an anxious desire for what is right."

The commission, having finished its investigations in England, visited India, and there renewed them in nearly every place of importance for obtaining information. It examined seven hundred and twenty-three witnesses, of whom four hundred and sixty-six were natives of India or China, including government officials, planters, landowners, traders, members of the professional classes, especially physicians, missionaries of nearly every denomination, military officers and private soldiers, and the chiefs and officials of the native states.

As a result of this elaborate inquiry, the commission, by a majority of eight to one, pronounced clearly and unhesitatingly in favor of the maintenance of the existing system of opium production and sale of opium in India; finding no evidence of extensive moral or physical demoralization arising in India from the use of the drug, or of any desire on the part of its people or of the Chinese Government to prohibit it.

The commission also decided, in respect to the effect on the finances of India of a prohibition of the sale and export of opium, that, "taking into consideration the compensation payable, cost of the necessary preventive measures, and the loss of revenue that would result from a policy of prohibition, the finances of India are not in a condition to bear the losses that such a policy would entail."

The testimony of the missionaries in India before the commission was not unanimous. That of the members of the American Methodist Episcopal and Canadian Presbyterian commissions,

and the representatives of the Presbyterian and Baptist missions, was in favor of prohibition. On the other hand, the views of the Episcopal bishops and clergy of Calcutta and Lucknow, and of the Roman Catholic Archbishop of Calcutta, were adverse to prohibition. Several of the former, however, frankly admitted that the evils of the opium habit, deplorable as they undoubtedly are, have been grossly exaggerated, and the good that it accomplishes has been but little recognized.

The use of opium in India and China is as much a natural habit as the use of alcohol among Western nations. It has been practiced in those countries for centuries, and it would seem impossible by legislation, and especially by the legislation of an alien nation, to do anything more than control the more manifest evils resulting from it. A policy of rigid restriction of the use of opium would unquestionably be a substitution of the use of opium by alcohol; and all the evidence given before the commission as to the evils arising from the opium habit showed, that as a source of social disorder, organic disease, insanity, and suicide, opium is not to be compared with alcohol.

NOTE.—For the full details of this most interesting inquiry, whether regarded from an economic, social, or medical point of view, reference is made to the First Report of the Royal Commission on Opium, with minutes of evidence and appendices, presented to Parliament in 1894, and to two final reports, Parts I and II, with historical appendices, etc., presented to Parliament in 1895, after the return of the commission from its visit to India.

PHOTOGRAPHING ELECTRICAL DISCHARGES.

BY WALTER E. WOODBURY,
EDITOR OF THE PHOTOGRAPHIC TIMES.

PHOTOGRAPHY plays many important parts in modern science. It assists the astronomer by revealing the existence of thousands and thousands of worlds veiled in the obscurity of immeasurable distance and invisible to the eye even when aided by the most powerful telescope in existence. The chemist has recognized the value of it in registering the belted zones of the spectrum. It aids the meteorologist by placing in his hands permanent records of the dark nimbus and the bright rolling cumulus clouds, the lightning flash, and the automatic registration of the rise and fall of the barometer and thermometer. The microscopist is able to photograph the disease-bearing generations of bacteria, vibrio, and schizomycetes, and to magnify their images a thousandfold for the benefit of the student. It determines the depth of the sea, the direction of currents, and the velocity of projectiles. It detects the spurious bank note or signature, the vibration of suspected bridges, and no traveler's equipment is

complete nowadays unless it contains a complete set of photographic apparatus.

These are but a few among the many things that photography does for us. Each year reveals some fresh uses to which it can be placed.

Quite recently the electrician has discovered its value to him in many ways, principally in registering electrical discharges, so that the same may be carefully studied at leisure. At a meeting of the British Association in 1892, Mr. A. A. Campbell Swinton showed some most interesting photographs of electrical discharges which are here reproduced (Figs. 1 and 2). According to an account of them given in the Electrical Review, these figures were

FIG. 1.—A POSITIVE DISCHARGE.

all obtained without the employment of a camera or lens, but produced by merely causing the electrical discharges to take place across the sensitive surface of an ordinary photographic dry

plate. Such a plate consists of a sheet of glass coated over with bromide of silver incorporated in a film of gelatin. When single positive or negative discharges are desired, the photographic plate,

Fig. 2.—A Negative Discharge.

the back of which is covered with tin foil, is placed between the two discharging points, and the strength of the discharge is regulated so that, while it shall cover as much of the plate as possible, it shall not spread over the edge. The tin foil performs a double function: it does away with the spark on the back of the plate, which would otherwise occasion a confused figure; and it also assists in causing a uniform spreading out of the discharge. It does not seem to modify the character of the figure produced in any way. It, however, affects its form, since, if the foil be smaller than the plate, the discharge seems to have a great disinclination to extend itself beyond the edge of the foil, but would even curve

round to avoid doing this. The arrangement adopted, when it is desired to obtain both positive and negative discharges simultaneously on the same plate, and when connecting sparks from positive to negative are desired, is similar, only in these cases the two discharging points are placed on the film side of the plate.

Fig. 3.—Sextuple Lightning Flash. (By Prof. Zenger.)

Many very beautiful photographs of lightning flashes have been made. They are not at all difficult to get. It is only necessary to wait for a suitable stormy night, point the camera containing the sensitive plate in the direction of the storm, remove the cap, and await the flash. The photographer of lightning flashes is sometimes startled to obtain in his finished picture streaks of lightning, some white and others *black*, the latter being produced by the flashes which were so actinic as to produce upon the sensitive film the phenomenon known as "reversal."

One of the most interesting photographs of lightning flashes that I have seen is that reproduced above. It has been kindly sent to me by Prof. Ch. von Zenger, the renowned meteorologist. It was made on May 20, 1894, when a terrific storm, of short duration fortunately, broke over the town of Prague. The lightning depicted in the photograph struck four houses at once, doing considerable damage. It will be noticed that descending from the clouds are six discharges; one flash can

be distinctly traced on its journey to the lightning conductor of the cupola of the Academy of Sciences.

The most interesting part of this photograph is the shadow of the cupola on the wet and foggy heavens. The intensity of the

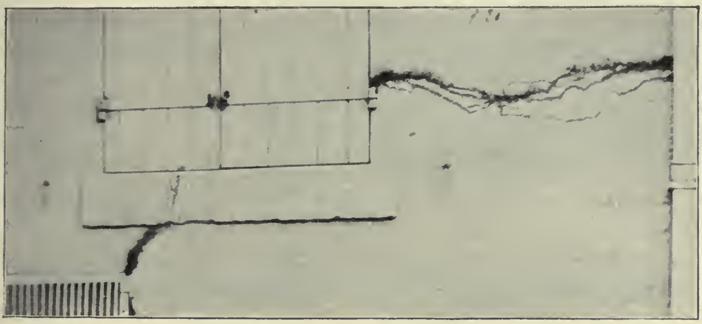


Fig. 4.—Traces of a Lightning Stroke.

light produced by the lightning is the cause of this peculiar effect, which I believe has never been obtained before or since. It is analogous with the phenomenon commonly known as the Specter of Brocken.

At a meeting of the Academy of Sciences, held a short time ago, Prof. Zenger read a most interesting paper upon the subject of Electricity as a Vortex Motion, in which he endeavors to prove that electrical discharges, no matter what their origin, produce a vortex motion on matter lying in the electric field. He makes the following experiment: A spark from a Ruhmkorff coil or a Wimshurst machine is discharged within the receiver of an air pump, under which has been placed a test tube containing diluted ammonia and another containing hydrochloric acid. At the instant of the discharge there will be visible eddies or little whirlwinds, rendered visible by the tiny crystals of ammonium chlorid suspended in the air. In circling about they are condensed into peculiar shaped veins which fall upon the plate of the air pump, arranging themselves in somewhat the same manner, says Zenger, as did the *débris* from the roofs and trees during the cyclone in the valley of Roux in Switzerland—i. e., they form lines of electric force.

Fig. 5.—Discharge of a Wimshurst Machine.

Prof. Zenger sends me some very interesting photographs in

support of the vortex theory. Fig. 4 shows the marks left by a stroke of lightning on the wall of a house at Mort, illustrating its course from the iron water pipe to the iron hinges of the window, and from thence to the iron sewer grating. For comparison he sends two other photographs (Figs. 5 and 6). These are obtained by the discharge of an immense Ruhmkorff induction coil containing one hundred thousand metres of insulated copper wire. Two small triangles of tin foil are glued opposite to one another on a photographic plate, and when dry the whole is

Fig. 6.—Discharge of a Ruhmkorff Induction Coil.

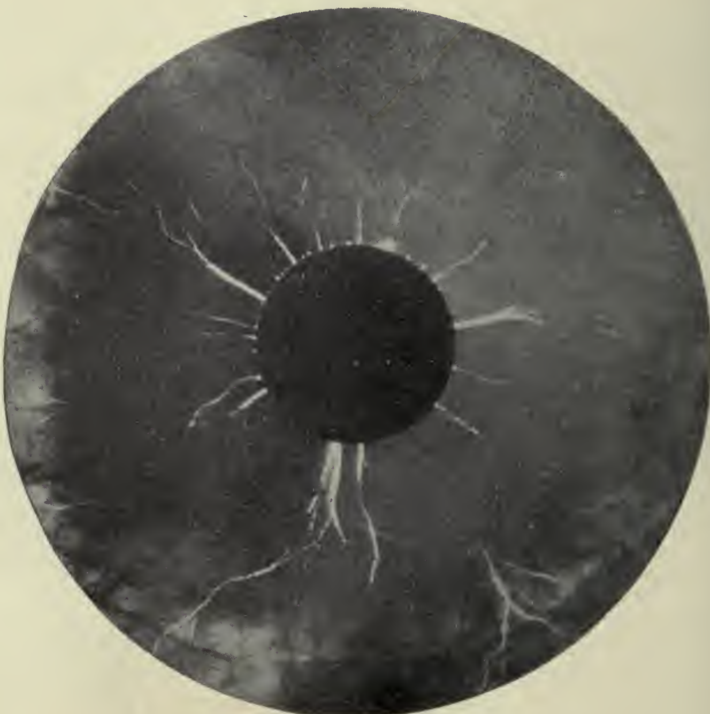


Fig. 7.—Artificial Solar Eclipse.

covered with a light brownish coating of lampblack. After the discharge a white track is found, as shown in the photographs. Both these pictures show evidence of the vortex motion of the

lampblack driven off by the discharge, and the same peculiar formation is seen in the lightning flash as in Fig. 4. Between the dark filament of intact lampblack and the borders of the electric tracings there is a multitude of fine helicoidal curves filling the white traces left on the smoked glass. These helicoidal spires proceed to the right and left, and on about the middle of the trace the destruction of the two opposing motions produces the phenomena of discharge, viz., light, heat, sound, and mechanical effects. Zenger claims that these, his experiments, serve to show that the undulatory theory of Herz is very defective, there being no motion in plane waves, nor, as in the case of polarized light, is there any in circular or elliptical waves on a cylindrical surface.

"I could show," writes Prof. Zenger, in a recent letter to the writer, "that the solar phenomena, such as the solar corona and

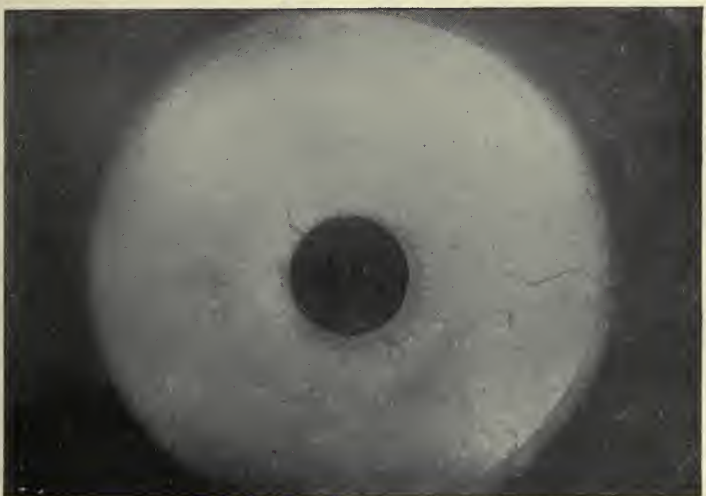


FIG. 8.—IMITATION OF THE SOLAR CHROMOSPHERE AND CORONA.

protuberances, are also due to electric discharges continually given off from the sun's surface. Fig. 7 shows the effect of positive discharges from a circular disk of tin foil into the smoked surface of a glass plate. It will be noticed that we have facsimiles of all the forms of solar protuberances. In Fig. 8 we see the effect of a positive discharge from a hollow hemisphere into the smoked surface of a glass plate, on the middle of which was fixed a lump of wax. The effects are analogous to the chromosphere and to the inner and outer layers of the solar corona produced by the superposition of the lines of electric force radiating from different parts of the spherical surface."

Prof. Zenger's photographs are remarkably interesting and

are valuable assistants in support of the vortex theory which he advances. I hope at an early date to supplement this article with some still more interesting examples of the photography of electrical discharges.

THE GENIUS AND HIS ENVIRONMENT.

By J. MARK BALDWIN,
PROFESSOR OF PSYCHOLOGY IN PRINCETON UNIVERSITY.

PSYCHOLOGICAL science has reached a sort of understanding in these recent years of the individual and of the social setting in which he customarily disports himself; and the duty now devolves upon it of dealing with the exceptions to the rule. No one will be disposed to deny certainly that the genius is in some way exceptional; and if any instance can, by showing what society is not, cast light on what it is, the genius is the man to question. So it is my purpose in this paper to endeavor to understand him, as far as may be, without putting ourselves in his shoes; for apart from the inherent difficulty of assuming his exceptional rôle, it may for another reason be more comfortable not to do so, for under the exceptions to our social rule we are forced to include also these other extremes found in the weak-minded and the insane.

The facts about the genius seem to indicate that he is a being *sui generis*. Common mortals stand about him with expressions of awe. The literature of him is embodied in the alcoves of our libraries most accessible to the public, and even the wayfaring man, to whom life is a weary round, and his conquests over Nature and his fellows only the division of honors on a field that usually witnesses drawn battles or bloody defeats, loves to stimulate his courage by hearing of the lives of those who put Nature and society so utterly to rout. He hears of men who swayed the destinies of Europe, who taught Society by outraging her conventions, whose morality even was reached by scorn of the peccadilloes which condemn the ordinary man, to whom might makes right, and *homo mensura omnium*. Every man has in him to some degree the hero-worshiper, and gets inflamed somewhat by reading Carlyle's Frederick the Great.

Of course, this popular sense can not be wholly wrong. The genius does accomplish the world movements. Napoleon did set the destiny of Europe, and Frederick did reveal, in a sense, a new phase of moral conduct. And the truth of these things is just what makes the enthusiasm of the common man so healthy and stimulating. It is not the least that the genius accomplishes that

he thus elevates the traditions of man, inspires the literature that the people read. He sows the seeds of effort in the fertile soil of the newborn of his own kind, while he leads those who do not have the same gifts to rear and tend the growing plant in their own social gardens. This is true: and a philosophy of society should not overlook either of the facts—the actual deeds and the peculiar influence of the great man upon their own time—or his lasting place in the more inspiring social tradition which is embodied in literature and art.

But it is not my aim to add to the literature of hero-worship. The considerations on that side are so patent that he who runs may read. My aim is to present just the opposite aspect of these apparent exceptions to the canons of our ordinary social life, and so to oppose the extreme claim made by the writers who attempt, in the name of social philosophy and science, to blur the lines of sane thought on these topics. For it only needs a moment's consideration to see that if the genius has no reasonable place in the movement of social progress in the world, then there can be no possible doctrine or philosophy of such progress. To the hero-worshiper his hero comes in simply to "knock out," so to speak, all the regular movement of the society which is so fortunate, or so unfortunate, as to have given him birth: and by his initiative the aspirations, beliefs, struggles of the community or state get a push in a new direction—a tangent to the former movement or a reversal of it. If this be true, and it be further true that no genius who is likely to appear can be discounted by any human device before his abrupt appearance upon the stage of history, then the history of facts takes the place of the science or philosophy of them, and the chronicler is the only historian with a right to be.

Our genius, then, is a very critical factor in human thought. Not only is he the man from whom we expect the thought; he is also the man who, if the hero-worshiper is right, traduces thought. For of what value can we hold the contribution which he makes to thought if this contribution runs so across the acquisitions of the earlier time, and the contributions of earlier genius, that no line of common truth can be discovered between him and them? Then each society would have its own explanation of itself, and that only so long as it produced no new genius. It may be, of course, that society is so constituted—or, rather, so lacking in constitution—that simple variations in brain physiology are the sufficient reason for its cataclysms; but a great many efforts will be made by the geniuses themselves to prove the contrary before this highest of all spheres of human activity is declared to have no meaning—no thread which runs from age to age and links mankind, the

genius and the man who plods, in a common and significant development.

It is, therefore, on the side of just this endeavor that I write. It seems that we have now at hand in our recent literature some social truths of such generality that certain things may be said of social progress which do not rob the genius of his credit, nor of his influence, even though they do tend to explain him. They go further, indeed, in that they explain him in the same terms and to the same extent that they explain the common man and society too. We may turn to these considerations.

I.

The first and most general position which has come as a new insight, in the confusion of present-day discussion, is indicated by a phrase which I have used elsewhere—"Social Heredity." The theory of social heredity has been worked up through the contributions, from different points of view, of several authors. I shall first expound this point of view in my own way, bringing out most prominently the aspects of social heredity which seem to be of value for the true "appreciation" of the genius. What, then, is social heredity?

This is a very easy question to answer, since the group of facts which the phrase describes are extremely familiar—so much so that the reader may despair, from such a commonplace beginning, of getting any novelty from it. The social heritage is, of course, all that a man or woman gets from the accumulated wisdom of society. All that the ages have handed down—the literature, the art, the habits of social conformity, the experience of social ills, the treatment of crime, the relief of distress, the education of the young, the provision for the old—all, in fact, however described, that we men owe to the ancestors whom we reverence, and to the parents whose presence with us perhaps we cherish still. Their struggles, the Fourth of July orator has told us, have bought our freedom; we enter into the heritage of their thought and wisdom and heroism. All true; we do. We all breathe a social atmosphere; and our growth is by this breathing-in of the tradition and example of the past.

Now, if this be the social heritage, we may go on to ask, Who are to inherit it? And to this we may again add the further question, How does the one who is born to such a heritage as this come into his inheritance? And with this yet again, How may he use his inheritance—to what end and under what limitations? These questions come so readily into the mind that we naturally wish the discussion to cover them, even apart from the requirement which is urged upon us, in these latter days, that we make all social discussion as biological as possible. The term heredity

does certainly bring up a biological line of thought, and the analogy from evolution doctrine is materially helpful; so we need not be afraid of it.

Generally, then, who is eligible for the social inheritance? This heir to society we are, all of us. Society does not make a will, it is true; nor does society die intestate. To say that it is we who inherit the riches of the social past of the race, is to say that we are the children of the past in a sense which comes upon us with all the force that bears in upon the natural heir when he finds his name in will or law. But there are exceptions. And before we seek the marks of the legitimacy of our claim to be the heirs of the hundred years of accumulated thought and action, let us say, of this American continent, it may be well to advise ourselves as to the poor creatures who do not enter into the inheritance with us. They are those who people our asylums, our reformatories, our jails and penitentiaries; those who prey upon the body of our social life by demands for charitable support, or for the more radical treatment by isolation in institutions: indeed, some who are born to fail in this inheritance are with us no more, even though they were of our generation; they have paid the penalty which their effort to wrest the inheritance from us has cost, and the grave of the murderer, the burglar, the suicide, the red-handed rebel against the law of social inheritance, is now their resting place. Society then is, when taken in the widest sense, made up of two classes of people—the heirs by right and the rebels by birth.

We may get a clear idea of the way a man attains his social heritage by dropping figure for the present and speaking in the terms of plain natural science. Ever since Darwin propounded the law of "natural selection" the word "variation" has been current. The student in natural science has come to look for variations as the necessary preliminary to any new step of progress and adaptation in the sphere of organic life. Nature, we now know, is fruitful to an extraordinary degree. She produces many specimens of everything. It is a general fact of reproduction that the offspring of plant or animal is quite out of proportion in numbers to the parents that produce them, and also to the means of living which await them. One flower produces seeds which are carried far and near—to the ocean and to the desert rocks, no less than to the soil in which they may take root and grow. Insects multiply at a rate which is simply inconceivable to our limited capacity for thinking in figures. Animals also produce more abundantly, and man has children in numbers which allow him to bury half his offspring yearly and yet increase the adult population from year to year. This means, of course, that whatever the inheritance is, all can not inherit it—

some must go without a portion in natural goods if the resources of Nature are in any degree limited. That the resources of Nature are inadequate to provide for such numbers, with the extraordinary increase, is a matter of course; for if not so now, how soon must it become so, as the increase goes on? Nature solves the problem in the simplest of ways: all the young born in the same family are not exactly alike; "variations" occur. There are those that are better nourished, those that have larger muscles, those that breathe deeper and run faster. So the question who of these shall inherit the earth, the fields, the air, the water —this is left to itself. The best of all the variations will live, and the others will die. Those that do, have thus, to all intents and purposes, been "selected" for the inheritance, just as really as if the parents of the species had left a will and had been able to enforce it. This is the principle of "natural selection."

Now, this way of looking at problems which involve aggregates of individuals and their distribution is becoming a habit of the age. Wherever the application of the principles of probability do not explain a statistical result—that is, wherever there seem to be influences which favor particular individuals at the expense of others—men turn at once to the principle of variations for the justification of this seeming partiality of Nature. And what it means is that Nature is partial to individuals *in making them*, in their natural heredity, rather than after they are born.

The principle of heredity with variations is a safe assumption to make in regard to mankind; and we see at once that in order to come in for a part in the social heritage of our fathers we must be born fit for it. We must be born so endowed for the race of social life that we assimilate, from our birth up, the spirit of the society into which we are reared. The unfittest, socially, are cut off. In this there is a distinction between this sphere of selection and that of the organic world. There the fittest survive, the others are lost; here the unfittest are lost, all the others survive. Social selection weeds out the unfit, the murderer, the most unsocial, and says to him, "You must die"; natural selection seeks out the most fit and says, "You alone are to live." The difference is important, for it marks a prime series of distinctions, when the conceptions drawn from biology are applied to social phenomena; but for the understanding of variations we need not now pursue it further.

Given social variations, therefore, differences among men, what becomes of this man or that? We see at once that if society is to live there must be limits set somewhere to the degree of variation which a given man may show from the standards of society. And we may find out something of these limits by looking at the evident, most marked differences which actually ap-

pear about us. First, there is the idiot. He is not available, from a social point of view, because he varies too much on the side of defect. He shows from infancy that he is unable to enter into the social heritage because he is unable to learn to do social things. His intelligence does not grow with his body. Society pities him if he be without natural protection, and puts him away in an institution. So of the insane, the pronounced lunatic; he varies too much to sustain in any way the wide system of social relationships which society requires of each individual. Either he is unable to take care of himself, or he attempts the life of some one else, or he is the harmless, unsocial thing who wanders among us like an animal or stands in his place like a plant. He is not a factor in social life; he has not come into the inheritance.

Then there is the extraordinary class of people whom we may describe by a stronger term than those already employed. We find not only the unsocial, the negatively unfit, those whom society selects with pity in its heart; but there are also the anti-social, the class whom we usually designate as criminals. These persons, like the others, are variations; but they seem to be variations in quite another way. They do not represent lack on the intellectual side always or alone, but on the moral side, on the social side, as such—for morality is in its origin and practical bearings a social thing. The least we can say of the criminals is that they tend, by heredity or by evil example, to violate the rules which society has seen fit to lay down for the general security of men taken together in the enjoyment of the social heritage. So far, then, they are factors of disintegration, of destruction; enemies of the social progress, which proceeds from generation to generation by just this process of social inheritance. So society says to the criminal also, "You must perish." We kill off the worst, imprison the bad for life, attempt to reform the rest. They too, then, are excluded from the heritage of the past.

So our lines of eligibility get more and more narrowly drawn. The instances of exclusion now cited serve to give us some insight into the real qualities of the man who lives a social part, and the way he comes to live it.

II.

Passing on to take up the second of the informal topics suggested, we have to find the best description that we can of the social man—the one who is fitted for the social life. This question concerns the process by which any one of us comes into the wealth of relationships which the social life represents. For to say that a man does this is in itself to say that he is the man so-

ciety is looking for. Indeed, this is the only way to describe the man—to actually find him. Society is essentially a growing, shifting thing. It changes from age to age, from country to country. The Greeks had their social conditions, and the Romans theirs. Even the criminal lines are drawn differently, somewhat, here and there; and in a low stage of civilization a man may pass for normal who, in our time, would be described as weak in mind. This makes it necessary that the standards of judgment of a given society should be determined by an actual examination of the society, and forbids us to say that the limits of variation which society in general will tolerate must be this or that.

We may say, then, that the man who is fit for social life *must be born to learn.* The need of learning is his essential need. It comes upon him from his birth. Speech is the first great social function which he must learn, and with it all the varieties of verbal accomplishment—reading and writing. This brings to the front the great method of all his learning—imitation. In order to be social he must be imitative, imitative, imitative. He must realize for himself by action the forms, conventions, requirements, co-operations of his social group. All is learning; and learning not by himself and at random, but under the leading of the social conditions which surround him. Plasticity is his safety and the means of his progress. So he grows into the social organization, takes his place as a *socius* in the work of the world, and lays deep the sense of values, upon the basis of which his own contributions—if he be destined to make contributions—to the wealth of the world are to be wrought out. This great fact that he is open to the play of the personal influences which are about him we call, in psychology, his "suggestiveness," and the influences themselves "suggestions"—social suggestions. These influences differ in different communities, as we so often remark. The Turk learns to live in a very different system of relations of "give and take" from ours, and ours differ as much from those of the Chinese. All that is characteristic of the race or tribe or group or family—all this sinks into the child and youth by his simple presence there in it. He is suggestible, and here are the suggestions; he is made to inherit, and he inherits. So it makes no difference what his tribe or kindred be; let him be a learner by imitation, and he becomes in turn possessor and teacher.

An entire department of so-called genetic pyschology is being written on this topic—the mode and method of the child's learning to be a man and a social man. I need not dwell upon it further here. But the case becomes more interesting still when we give the matter another turn, and say that in this learning all the members of society agree; all *must be born to learn the same things.* They enter, if so be that they do, into the same social in-

heritance. This again seems like a commonplace remark enough, but certain things flow from it. Each member of society gives and gets the same set of social suggestions, the differences being the degree of progress each has made, and the degree of faithfulness with which each reflects what he has before received. This last difference is, again, a phenomenon of variation and brings us back to the genius; but I wish to neglect him a little longer, in order to point out another fact which is fundamental to what is distinctive in this paper.

There grows up, in all this give and take, in all the interchange of suggestions among you, me, and the other, an obscure sense of a certain social understanding about ourselves generally —a *Zeitgeist*, an atmosphere, a taste, or, in minor matters, a style. It is a very peculiar thing, this social spirit. The best way to understand that you have it, and something of what it is, is to get into a circle in which it is different. The common phrase "fish out of water" is often heard in reference to it. But that does not serve for science. And the next best thing that I can do in the way of rendering it is to appeal to another word which has a popular sense, the word *judgment*. Let us say that there exists in every society a general system of values, found in social usages, conventions, institutions, and formulas, and that our judgments of social life are founded on our habitual recognition of these values, and of the arrangement of them which has become more or less fixed in our society. For example, to say "I am glad to see you" to a disagreeable neighbor shows good social judgment in a small matter; not to quarrel with the homœopathic enthusiast who meets you in the street and wishes to doctor your rheumatism out of a symptom book, that is good judgment. In short, the man gets to show more and more, as he grows up from childhood, a certain good judgment; and his good judgment is also the good judgment of his social set, community, or nation. The psychologist might prefer to say that a man "feels" this; perhaps it would be better for psychological readers to say simply that he has a "sense" of it; but the popular use of the word "judgment" fits so accurately into the line of distinctions I am making that I shall adhere to it. And so we reach the general position that the eligible candidate for social life must have good judgment as represented by the common standards of judgment of his people.

It may be doubted, however, by some of my readers whether this sense of social values called judgment is the outcome of suggestion operating throughout the term of one's social education. This is an essential point, and I must just assume it. Its consideration falls under the method of the child's learning, which I have referred to as too great a topic to treat in this article.

Yet I may say that it will appear true, I trust, to any one who may take the pains to observe the child's tentative endeavors to act up to social usages in the family and school. One may then actually see the growth of the sort of judgment which I am describing. Psychologists are coming to see that even his sense of his own personal self is a gradual attainment, achieved by the child through his imitative responses to his personal environment. His thought of himself is an interpretation of his thought of others, and his thought of another is due to further accommodation of his active processes to changes in his thought of a possible self. And around this fundamental movement in his personal growth all the values of his life have their play. So I say that his sense of truth in the social relationships of his environment is the outcome of his very gradual learning of his personal place in these relationships.

We reach the conclusion, therefore, from this part of our study, that the socially unfit person is the person of poor judgment. He may have learned a great deal; he may in the main reproduce the activities required by his social tradition; but with it all he is to a degree out of joint with the general system of estimated values by which society is held together. This may be shown to be true even of the pronounced types of unsocial individuals whom we had occasion to speak of at the outset. The criminal is a man of poor judgment. He may be more than this, it is true. He may have a bad strain of heredity, what the theologians call "original sin"; he then is an "habitual criminal" in Lombroso's distinction of types, and his own sense of his failure to accept the teachings of society may be quite absent, since crime is so normal to him. But the fact remains that in his judgment he is mistaken; his normal is not society's normal. He has failed to be educated in the judgments of his fellows, however besides and however more deeply he may have failed. Or, again, the criminal may commit crime simply because he is carried away in an eddy of good companionship, which represents a temporary current of social life; or his nervous energies may be overtaxed temporarily or drained of their strength, so that his education in social judgment is forgotten: he is then the "occasional" criminal. It is true of him also that while he is a criminal he has lost his balance, has yielded to temptation, has gratified private impulse at the expense of social sanity; all this shows the lack of that sustaining force of social consciousness which represents the level of righteousness in his time and place. Then, as to the idiot, the imbecile, the insane, they, too, have no good judgment, for the very adequate but pitiful reason that they have no judgment at all.

[*To be continued.*]

PROPOSED SYSTEM OF CONTINUOUS POLAR EXPLORATION.

By ROBERT STEIN,
UNITED STATES GEOLOGICAL SURVEY.

THE objects of polar exploration are fourfold:

1. Commerce.—According to General Greely, whaling has contributed over six hundred and eighty million dollars to the wealth of Holland, England, and the United States. Exploration will probably reveal new whaling grounds. *If treated with some forbearance,* the whale will restock the Arctic Ocean. Forbearance will restore the wealth in reindeer, which, with musk oxen, foxes, bears, seals, walrus, and narwhal, will supply desirable commodities. The known deposits of guano and valuable minerals may eventually be utilized, and others will be discovered. Alaska may not be the only gold-bearing arctic land.

2. Scientific Research.—To ascertain with greater precision the shape, size, and density of the earth, the astronomer's base of measures, and thus render the science of surveying more accurate, ten pendulum observations near the unknown extreme of the arc are worth a hundred elsewhere. Observations on magnetism, especially near the magnetic pole, will benefit the thousands of ocean vessels which largely depend for their safety on the precision with which the compass can be interpreted. To the meteorologist the arctic is of special importance, because it presents the extremes of a world-embracing system, each of whose parts affects every other. Tides and currents are similarly interdependent. The aurora can best be studied where it is most common and most fully developed. Observations on the character and behavior of plants and animals under the unique conditions of the arctic will give to the student of organic life a more thorough mastery of his problems. To that end the hydrography must be known (depth of sea, temperature, water movement, sea bottom, salinity, light). The arctic affords the best facilities for studying one set of geologic forces (glaciers, icebergs, frost fissuring) in their extreme manifestation. The condition of the earth in past geologic epochs will not be fully known until the strata of the arctic lands have been mapped. To the paleontologist the arctic has already yielded most valuable information in the fossil evidence of a mild climate. Lockwood and Brainard found the slopes of western Grinnell Land studded with large petrified tree stumps. These and similar fossils, precious to museums or geologic cabinets, can probably be reached by way of Hayes Sound. To the ethnologist the Eskimos represent a phase of human life without a parallel. Museums need collections to illustrate these

lines of research. Thus the objects sought are well defined; but, apart from this, the very fact that there exists an unknown area of over a million square miles creates the duty to explore it, for two reasons: First, every new fact recorded, every misconception corrected, expands the mental horizon, gives additional power to the mind, and shuts off possible sources of error—an ounce of fact being worth a ton of speculation; second, every fact is part of a network, and as new facts are observed and correlated they constantly throw light on others, and presently group themselves into fruitful combinations. The most important discoveries have been made by men seeking simply to find out new facts, without regard to their consequences, or, rather, with the conviction, drawn from past experience, that no fact is without its useful consequence, and that therefore it would be a dereliction of duty to neglect any fact within reach. Think of Volta, Galvani, Oersted, Faraday, Crookes, Hertz, Röntgen! "Shall the northern limit of America remain unknown?" is a question which appeals to every American, even though he can not tell why. It may safely be said that there is nowhere a more assured prospect of filling many awkward gaps in scientific systems than in the arctic. If it be objected that this research should be postponed to a time when it can be done safely and economically, the answer is that this time has arrived.

3. Outing.—For the tourist, the arctic, with its marvelous scenery, its inspiriting climate, free from colds and fevers, quickly doubling appetite, vigor, and endurance (as testified unanimously by whalers and explorers), is at least equal to Yellowstone Park or the Alps. The Hamburg-American line already sends an excursion steamer to Spitzbergen. "The northern limit of phthisis" in Berghaus's Physical Atlas may be a message of hope to many a stricken home.

4. Honor.—Only hypocrisy can say that it does not desire the world's applause; only ignorance can say that the world proportions its applause to service rendered. Nothing arouses popular interest and wins popular homage more readily than successful arctic exploration. Supposing that this indicates no great discernment in the public, that does not alter the fact that a popular reputation is one of the most precious of human possessions—a capital enabling its possessor to apply his labor in any direction with vastly increased efficiency. If it is proper to strive for a capital in money, it is at least equally proper to strive for a capital in fame. And if fame be won by rendering important resources available, securing a vast array of scientific facts and giving access to unparalleled wonders, will it not be as fairly earned as many kinds which pass unchallenged?

He who understands the bearing of scientific facts knows

them to be worth more to humanity than tons of whalebone or ingots of gold; and as no reproach is cast on those who risk their lives for money, one might justify even the risk of life for scientific research in the arctic. But there is no need of this. Every careful student knows that in most cases the work involved no risk nor even greater hardship than is welcomed by an active man. Dr. Boas spent a year in Baffin Land in comfort and safety, traveling hundreds of miles, with Eskimo guides or alone, living mostly on the game of the country, and bringing back an unprecedented harvest of scientific facts, at a cost of seven hundred dollars. Considering the desultory character of most of the past work, the wonder is that disasters have been so few. Each explorer had to proceed independently to formulate his plan from book knowledge; inquire for means to obtain outfit and transportation; knock at a hundred doors before he met his patron; gather a party of novices; then start out with the haunting consciousness that, if he failed to accomplish anything in the limited time at his disposal, he would not have another chance. After returning he was generally unable, owing to the expensive methods of the past, to take the field again; his companions, with their precious experience, scattered over the world. The next expedition had to go through the same process. Could any business, say farming, be profitably conducted if the farm was worked one year and then abandoned for ten years?

"Arctic exploration," says Mr. Peary, "must, like anything else, be made a *business* and carried on from year to year, profiting by each added item of experience, taking advantage of every occurring opportunity." By doing the easiest and safest work first, the next will be made easier; and when a corps of experts has been developed, the list of difficult tasks will dwindle to very little. Lockwood and Brainard, in 1883, accomplished in six days a distance which it had taken them twenty-two days to accomplish the year before. "Hazardous expeditions into the open ocean," says Dr. Boas, "without the shelter of land and without any line of retreat, such as De Long's expedition, must be abandoned, as they will almost always end in disaster. Progress must be made cautiously and founded on the discoveries and experiences of past expeditions. It is only thus that scientific results can be obtained."

The expedition to Jones Sound, planned for 1897, is intended to initiate a system of continuous arctic exploration. Its object is to be the scientific research above indicated, and to this all else will be subordinated. Special attention will be paid to geology. Disasters having been plainly due to lack of a secure and always accessible base, the first object will be the establishment of a base at the mouth of Jones Sound, which Julius von Payer calls "the

one spot most suitable for such a base."* Being in assured annual communication through the Scotch and Newfoundland whalers, a well-housed and well-provisioned party, with some Eskimo families, will be as safe there as anywhere on earth, and will have before it a field unequaled in richness and extent. To the north, the west coasts of Ellesmere Land and Grinnell Land are to be explored; to the northwest, the triangle between those coasts and the Parry Islands is to be rescued from the unknown; to the west, the interior of North Devon is an interesting problem; to the southwest, Prince Regent Inlet *may* present an avenue to the magnetic pole; to the south, Baffin Land—with its Eskimo settlements, its herds of reindeer, its wealth in fishes and birds, its fossils and minerals—offers a tempting field, larger than the British Isles. Even Greenland may not be beyond the sphere of that strategic point.

Such a system, once initiated, will cost very little. Lecturing tours and the sale of collections will defray a large part of the cost. Considering the enormous sums spent on arctic exploration in the past by governments and by individuals, it seems probable that when the system is once in running order it will not lack patrons. The cost of the initial expedition is estimated at five thousand dollars. Much smaller sums will probably suffice in subsequent years.

OPINIONS.

Mr. Stein's plan is to establish a permanent station at the entrance of Jones Sound, to be occupied by from four to six white men and several Eskimo families, and from there carry on systematic scientific explorations northward, northwestward, westward, and southward as far as can be done with safety.

This plan is justly called by Julius von Payer "the best imaginable," for the reason that—

1. It is one of the safest, because its base station is annually reached by the whaling steamers.

2. It promises extensive scientific results, because that base gives access to a wide and rich field.

3. It is the cheapest, because of the possibility of utilizing the whalers as means of transportation.

4. It avoids hurry, which is a great source of danger and of imperfect work.

5. It permits the utilization of experience, allowing the same force to remain in the field for several years and to train their successors.

The main object of the first season's work will be the installation of the party. From my experience I am convinced that this initial work is prac-

* The advantages of the Jones Sound route were pointed out by Dr. Boas in 1887, and by Elisée Reclus in 1890. A gradual and systematic advance has been advocated by many geographers.

tically free from risk, especially since Eskimos are to be employed. (R. E. Peary, civil engineer, U. S. Navy.)

It is Mr. Robert Stein's merit to have called attention to the remarkable fact that the most northern portion of our continent has so far remained unexplored, not on account of the inherent difficulties of access, but on account of historical facts which directed the attention of explorers to Lancaster Sound and its western continuation, and to Smith Sound and its northern continuation. All the facts that are known—and these are quite numerous—indicate that the northernmost portion of the arctic American archipelago can be reached without danger and can be explored with comparative ease.

Mr. Stein points out that the point of attack is Jones Sound, which has so far been entirely neglected by explorers. Profiting by previous experience, Mr. Stein proposes to establish a station at the entrance of Jones Sound, thus giving his operations the necessary security and practically excluding all danger of serious accidents. The entrance of Jones Sound is visited annually by whalers, who will keep the explorers in contact with the civilized world, and who can furnish supplies and help if needed. There is no doubt that a small number of scientists, supported by a few Eskimo families, will be able to thoroughly explore the outlines of all the unknown islands and bring home material results in all branches of natural science, and that they may add important observations on the physical conditions of the arctic zone. The field of exploration has the immeasur able advantage that it can be easily reached either by a special vessel or by means of whalers; that exploration is, one might say, absolutely safe; and that it is certain to yield results which will rank with the best achievements in arctic explorations.

It is Mr. Stein's intention to confine the first season's work to the establishment of a base station and the exploration of its immediate vicinity. It is his plan to engage the help of a number of Eskimos, and to limit the party to from four to six scientists. The experience of C. F. Hall, of Schwatka, and my own proves that such work is practically free from risks of any kind, and I do not hesitate to express my conviction that even the first year's work will amply repay the expense incurred in fitting out the expedition. (Dr. Franz Boas, explorer of Baffin Land.)

Your committee believe that this expedition is thoroughly safe and practicable; that it is desirable for scientific purposes; and that no part of the arctic regions gives promise of greater opportunities for extensive discoveries with a minimum of danger, hardship, and expense. (National Geographic Society, Washington, D. C.)

Whereas a systematic exploration of Ellesmere Land is projected, always within easy reach of a base of supplies : *resolved*, that the Anthropological Society of Washington heartily indorse both the exploration and the plan of operations proposed by Mr. Robert Stein.

The west coast of Ellesmere Land is, in my opinion, the one field of exploration in all the arctic that promises the largest results with the least amount of labor and danger. (General A. W. Greely, U. S. Army.)

I am pleased to see you lay so much stress on the one point on which I have always insisted—that no step should be taken in arctic exploration

until you know that your depot of provisions is actually established. (Commodore G. W. Melville, U. S. Navy.)

An expedition ought to provide for a successful retreat. This you have done by placing your supply depot in the line of the Scotch whaling vessels. There can be no question but that the region which you propose to explore is rich in animal life. In 1872 and 1873, at Lifeboat Cove, Eskimos told me that west of the mountains there were large quantities of deer and musk oxen. (R. W. D. Bryan, astronomer to Hall's Polaris expedition.)

I consider the exploration of the west cost of Ellesmere Land by the mode suggested in your paper not only entirely practicable but certain to obtain most valuable results with the minimum expenditure of money. (Colonel H. W. Feilden, naturalist to the Nares expedition.)

Stein is evidently on the right track. (Admiral Sir George S. Nares, commander of the British expedition of 1875–'76.)

I hail with delight your plan of systematic exploration of the arctic lands. Since it looks forward to an indefinite future, you can wait quietly till the work grows of itself, not only areally, but also in minuteness. (Dr. A. Supan, editor Petermann's Mitteilungen.)

I congratulate you on your selection of Jones Sound as the route of advance, since that is a far less dangerous avenue than many others. (Elisée Reclus, author of Nouvelle Géographie Universelle)

The most important idea in your plan, and one which will mark a new epoch in arctic exploration, is the idea of a permanent camp at the entrance of Jones Sound, where it will be in constant communication with the outer world through the whalers. The wonder is that so simple and inexpensive a measure was not thought of long ago. Had it been adopted, say fifty years ago, it is entirely probable that arctic history since then would have remained unclouded by a single disaster. (Lieutenant D. L. Brainard, U. S. Army, of the Greely party, who, with Lockwood, reached the highest north ever attained, 83° 24·5'.)

Your project is in every way well conceived, and will no doubt yield the best results. Attempts to reach the pole have not met with results commensurate to the efforts made. Far more fruitful to science is the methodical exploration of an arctic land. The American archipelago is as yet unknown to the west of Ellesmere Land. To American naturalists belongs the task of revealing to science this *terra incognita*, and your project seems to me to be the most rational method. (Charles Rabot, explorer of Lapland, Spitzbergen, Iceland, and Greenland.)

You have hit upon one of the best routes for further discovery, and I am pleased to see that you are impressed with the necessity for a safe depot. (Clements R. Markham, C. B., President Royal Geographical Society of London.)

Mr. Koldewey, Councilor to the Admiralty, is of opinion that your project, which is well worked out in all its details, deserves to be received with interest by all friends of polar research. (Geographic Society of Hamburg.) (Captain Koldewey commanded the two German arctic expeditions of 1868 and 1869.)

I must confess the most active sympathy with the objects in view in all polar research, and I am convinced that the observations of physical phenomena there are to be ultimately of much practical benefit to us in these lower zones in our commerce and in the safety of our lives upon the high seas; but, unless systematically organized and continued through a series of years, we may expect small results. (Commander W. S. Schley, U. S. Navy, the rescuer of Greely.)

There is a line of possible discovery of the utmost importance lying between the Miocene deposits and the Pleistocene glaciation—viz., the finding of Pliocene beds that indicate the climatic conditions of the region just preceding the glaciation. All deposits later than the fossiliferous Miocene possess extreme interest. (Dr. T. C. Chamberlin, Professor of Geology, Chicago University, formerly President University of Wisconsin, and Chief of Division of Glacial Geology, United States Geological Survey.)

The Board of Managers of the Imperial Royal Geographic Society of Vienna has carefully examined Robert Stein's project of continuous polar exploration, and welcomes it with the utmost satisfaction. In the domains of oceanography, meteorology, terrestrial magnetism, the determination of gravity, plant and animal life, a new expedition would be of high scientific importance. For this purpose the plan designed and elaborated by Mr. Robert Stein seems especially suitable. At the request of the society, the well-known explorer, Julius von Payer, has also expressed his opinion.

A "secure base of operations" can only be had on land, and even there only at a few points in the polar region. It is the merit of Mr. Stein to have discovered the one spot most suitable for such a base. Mr. Stein's plan has my full approval, and, for geographic exploration in the far north, it is thus far the best imaginable. (Lieutenant Julius von Payer, explorer of Franz Josef Land.)

ON OUR BANKING SYSTEM.

By LOGAN G. McPHERSON.

IT is not to be supposed that many of the heads of the six million families in the United States whose incomes are less than six hundred dollars a year ever have in their possession more than a few dollars that are not required for immediate needs. A considerable number of those having larger incomes frequently are in possession of money which they are not obliged to spend at once, and merchants and manufacturers and others who direct on a large scale the efforts of many employees are frequently in possession of considerable sums which they do not immediately need to use.

Especially among English-speaking people has grown the custom of depositing such money in banks. Primary and elementary points of the banking problem are therefore the provision of receptacles for money that will withstand the forces of Nature and the assault of thieves; the securing of custodians who are

honest and competent to receive and record deposits and to make payments with accuracy. That the strong and well-guarded vaults of modern banks meet the first of these points is evidenced by the decreasing list of bank robberies that are accomplished by physical force. The examination of bank employees' character, that has become the more searching and rigid as the operations of guarantee companies have extended, is causing defalcations through the direct stealing of funds to become constantly fewer.

As banks have become more numerous, the use of checks has increased. Between office and store, factory and warehouse, bank and bank, city and city, millions of these pieces of paper are continually in transit, furthering the exchange of human effort. The interlinking of banks as correspondents and the growth of clearing houses have formed a mechanism whereby their payment is effected with celerity.

But the actual deposits of a bank are increased by the proceeds of loans which it makes and which are frequently placed to the credit of the borrower the same as though money had actually been deposited by him. For example: A bank discounts a note from A to B at sixty days for one thousand dollars. The proceeds, amounting to nine hundred and ninety dollars, may not be instantly needed by B; the amount is placed to his credit for him to check against—that is, nine hundred and ninety dollars is placed to his credit on the books of the bank. As his checks come in he is charged with their amount on the books of the bank. In this way he obtains from the bank the use of nine hundred and ninety dollars; or, to speak more accurately, the bank is the guarantor of representatives of value issued by him to the extent of nine hundred and ninety dollars. He has deposited no money. What he has deposited has been a promissory note—that is, a promise to produce the result of human effort of which he can dispose for at least the value of the note. As a bank's profits are largely made by discounting notes, a very considerable portion of the checks issued against every bank, therefore, are not drawn against money deposited in it, but against credits in its books, which are based upon the assurance of the forthcoming of the result of human effort. And therefore a vast proportion of all the checks that flit between store and office, city and city, are based, not upon cash directly, but upon the guarantee of a bank that it will accept checks to the value of the result of human effort, the assurance of the production of which has been discounted or purchased by it and held as the basis for its guarantee.

In the case specified, the exhaustion of his credit by B might be somewhat as follows: At the end of the week, to pay his employees, he may draw two hundred dollars from the bank. In this instance the bank advances to him out of that portion of its

deposits in actual money which it retains to meet current demands, coins, or circulating notes, to the amount of two hundred dollars. B may have employed C, a contractor, to make some repairs at his place of business, and he gives C a check on the bank for ninety dollars. C also has an account at the bank and deposits the check to his credit. The bank on its books charges B with ninety dollars and credits C with ninety dollars. B's debt to C has been paid without the use of money at all, the bank, in this instance, acting as a register of the exchange of human effort. B may have purchased goods in New York from X Y & Co. to the value of three hundred dollars. He delivers a check to his bank for that amount, and the bank delivers to him a draft on its correspondent bank in New York for three hundred dollars. B mails the draft to X Y & Co., who have an account at the bank on which it is drawn, and deposit it in that bank to their credit. This bank charges the original bank on its books with three hundred dollars, and credits X Y & Co. on its books with three hundred dollars. No money has been used in the entire transaction. Representatives of value based upon the note of A to B have caused the transfer of credits in the books of the original bank and in the books of the New York bank.

These instances indicate the manner in which, by the aid of the banking system, the exchange of the results of human effort is promoted to an extent far transcending the possibilities of exchange effected only by the use of coins or by the direct representatives of coins. By means of checks and drafts based on book credits in banks that are based on the assurance of the result of human effort as given by promissory notes, a very considerable portion of the commerce of civilization is forwarded, the proportion of exchanges effected by coins or the direct representatives of coins being in constantly decreasing ratio to the total value of exchanges. But, as when there is a scarcity of coin among the members of a race who have progressed to the use of coin, the exchange of effort between them is hindered and reverts to barter; as, when there becomes a scarcity of circulating notes among a nation accustomed to their use, commerce and manufacturing are restricted because, in the absence of other expedients, exchanges are necessarily conducted by coin, so in our banking development, when promissory notes and other securities are regarded with distrust by the banks upon which is devolving the most of the burden of directly or indirectly supplying the money needed in a community, there is a restriction of the exchange of human effort. Manufacture and commerce are retarded, and are forced to the exclusive use of coins or their direct representatives.

A most important point of the banking problem, therefore, is the regulation of discounts in such a manner that the commerce

of a nation may proceed with regularity, and its development be continuous and orderly.

Suppose that the money actually deposited in a bank amounts to one hundred thousand dollars. The bank knows from experience that it will not need to keep more than fifty thousand dollars of this to meet current demands, and therefore discounts notes to the extent of fifty thousand dollars. It has received money to the extent of one hundred thousand dollars, promises to pay money to the extent of fifty thousand dollars, and made itself liable to the extent of one hundred and fifty thousand dollars—that is, it is responsible for the payment of checks to an amount fifty per cent in excess of the amount of money which it has received. A definite amount of money is made the basis of liability for an amount one and a half times as great. But a bank discounts not only from its actual deposits, but also from its surplus of accumulated profit, and such of its capital as is not invested in real estate, bank building and fixtures. Suppose that the money actually deposited in a bank amounts to a hundred thousand dollars, that it has a surplus of two hundred thousand dollars, and its capital in excess of the amount invested in bonds, real estate, and banking house is two hundred thousand dollars; its funds available for discount thus amount to five hundred thousand dollars. As the only legal restriction upon the extent of its discounts is the requirement that it maintain a reserve in actual money amounting to twenty-five per cent of its deposits, it is obvious that by keeping on hand a hundred and fifty thousand dollars in actual money, its statement of deposits may show six hundred thousand dollars. Of this a hundred thousand dollars is actual money received as deposits and five hundred thousand dollars the proceeds of discounted notes. And thus it is evident how it is possible for by far the greater portion of the exchanges of the country to be effected by representatives of value based upon the assurance of the production of human effort contained in promissory notes. It must be recognized that this furthering of the exchange of the result of human effort may be of vast benefit to the public as a whole. For example, a Southern planter, with ripening acres of cotton, may not have the means wherewith to pay for the picking, cleaning, packing, and freight to the place of market. The proceeds of a note discounted at a bank will provide him with the necessary means, and he pays the note with the money obtained from the sale of the cotton. Likewise with an elevator owner in Chicago purchasing grain for export; or a coal operator of Pittsburg who desires to send fuel by river to the Southern, or by lake to the Northwestern markets; or a merchant with store, clerks, and knowledge of the wants of his section may give his notes for needed goods which he pays from the

proceeds of their sale; or a man, far-sighted, energetic, and careful, may perceive opportunity for profit if he could obtain the requisite material or the requisite tools or requisite help of other kinds. By having a note discounted, he obtains the requisite help and pays the note when the opportunity has been realized. In these instances, the discount of notes has contributed to the production and distribution of needed commodities. The producers have obtained profit, their employees have obtained wages; railways, vessels, and factories have been used with emolument to their owners and employees, and thousands of people have been placed in possession of food, fuel, and clothing.

But where there is a chance for profit, there also is a chance for loss. Flood may ruin the cotton crop, the markets may become so glutted that neither grain nor coal can be sold except at a greatly depreciated price; the merchant may be stricken in health; even the energetic, careful, and far-sighted man may have miscalculated his opportunity. In such cases, the result of human effort to the value of the notes may not be forthcoming; the assurance fail of performance; the notes can not be met. When representatives of value are based upon the promised result of human effort which does not materialize, they are worthless unless there is an ultimate basis of realized result. This realized result may be the property of signers or indorsers taken by the bank to make the value of the notes good; it may be of the capital or surplus of the bank or property of the stockholders who are liable for double the amount of their holdings; or, in the last resort, the loss falls upon individuals of the public in general.

Concerned, therefore, in the conduct of a bank are the stockholders, who profit by its prosperity and share its losses; the depositors, whose funds are in its custody, and the public in general; and an important phase of the banking problem is presented by three points: First, the necessity for a bank to keep on hand sufficient actual money wherewith to meet checks and drafts upon it that must be paid in actual money; second, the necessity for furthering the exchange of human effort and thereby making as large profits as possible by maintaining as large a line of discount at all times as may be prudent; third, to make no loans except upon adequate security.

When a bank discounts a note, its first consideration, of course, is the probability of the note being paid—that is, it desires to be reasonably sure that the transaction which the note covers will yield enough to cancel it. To this end it is obliged to rely largely upon the reputation for ability and honesty of the drawer and indorser, for it can not enter into the details of every transaction; but a general knowledge of prices and markets is useful, that it may not be overflooded with paper in any particular line of in-

dustry that may be offered by the oversanguine or the knavish. And the attempts to obtain discounts by the oversanguine and the knavish are not limited to the offer of paper in excess of the amount abundantly necessary to cover the movement in any particular line, but they frequently exchange notes, or in other ways obtain paper from a colleague which represents no legitimate business transaction, but by the discount of which they obtain needed funds.

As unpredicted circumstances may, at unforeseen times, cause unusual demands to be made upon a bank's deposits, it follows that a bank's loans should not be for long periods. In actual practice the average duration of notes is sixty days, and banks do not like to accept paper running longer than four months under any circumstances. Different notes coming due at different times bring into a bank day by day funds which it can use to discount new notes, or which it can retain in case of contingency requiring it to keep more money on hand than usual.

It is evident that a bank should not only be reasonably certain that the prospective exchange of effort which is the immediate cause of a loan should produce enough under ordinary conditions to cancel it, but that in case of contingency that is disastrous to the products immediately concerned the property of the signers and indorsers of the note not covered by other obligations be sufficient to liquidate it. But in these days, when a concern's property is not always visible and its incumbrances frequently concealed, a knowledge of its actual resources is difficult to obtain. It has happened that financial tricksters, by operations in several banks, knowledge of each of which has been kept from the others, have gained possession of funds far beyond the extent to which their resources entitle them, and in such a case, when any one bank suspects that it is being victimized, there is the temptation for it to conceal this knowledge from the other banks, that the unworthy customer may not be prevented from obtaining loans from them, wherewith he can repay the advances made by the bank which has begun to suspect him.

Perhaps the possibilities of unwholesome financiering which must finally result in loss to the banks and disturbance to all the communities concerned can best be illustrated by a definite example traced throughout its ramifications.

From a region rich in deposits of coal a railway extends to docks where coal is loaded into vessels for shipment to remote markets. A corporation controlled by a coal operator and the president of the railroad leases the docks, and engages in the purchase and shipment of coal. The railway is financially weak and the corporation without working capital. But the corporation buys large quantities of coal, giving four months' notes that ag-

gregate thousands of dollars in payment therefor; it gives four months' notes to the railroad company, aggregating thousands of dollars, in payment for the freight to the docks. The coal producers, to obtain ready money wherewith to run their mines, discount the notes obtained from the shipping company in their banks. The railroad company, to obtain ready money wherewith to meet its expenses, discounts the notes obtained from the coal company for freight in its different banks. It is the intention of the coal-shipping company to pay the notes for coal and the notes for freight when the coal which it has shipped is sold, but, finding it easy to issue notes, it buys and ships more coal than it can sell at remunerative prices, or for immediate returns, and when its notes are due it can not pay them all. To retain its credit with the coal producers, it pays the notes given to them, but it then can not pay all the notes given the railroad company. To meet the situation, the railroad company and the coal company exchange notes—that is, for example, suppose there be notes amounting to forty thousand dollars of the coal company to the railroad company coming due, and the coal company can pay but twenty thousand dollars. To meet the other twenty thousand dollars, which may be in two notes of ten thousand dollars each, which have been discounted by the railroad company at the P National and the Q National Banks, the railroad company gives the coal company two notes each for ten thousand dollars, and the coal company gives the railroad company two notes each for ten thousand dollars. One note of the coal company to the railroad company is discounted at the R National and the other at the S National Bank, and the treasurer of the railroad company, by that part of the transaction, is in possession of twenty thousand dollars, less the discount, which he badly needs to help pay interest on an overburden of bonds and bills and long-overdue wages to employees. One note of the railroad company to the coal company is discounted at the T National and the other at the U National Bank, and the proceeds, amounting to nearly twenty thousand dollars, in connection with the twenty thousand dollars already in its treasury, enable the coal company to meet the maturing notes to the railroad company for forty thousand dollars. The bank in which they are paid and the P National and Q National Banks at which they have been discounted have their belief in the ability of the coal company to meet its obligations strengthened, because it appears that the coal company is paying its notes. But this is not really so, for only one half of its original notes has been paid, and the notes exchanged, representing a liability of forty thousand dollars, leave the amount of discounts in various banks the same as when the original notes of forty thousand dollars of the coal company to the railroad company were discounted.

Suppose a similar transaction to be undergone with each of three sets of notes given by the coal company to the railroad company, each set originally amounting to forty thousand dollars. Instead of the original indebtedness of one hundred and twenty thousand dollars of the coal company to the railroad company, there is created by the exchange of notes for half that amount a joint liability of the coal company and the railroad company for one hundred and twenty thousand dollars. The coal has all been sold, but how is it with the coal company? How is it with the railroad company? And how is it with the banks that have discounted their notes?

The coal company continues business, giving new notes to coal producers for coal purchased, and new notes to the railroad company for freight. It is responsible not only for these notes, but for the previously issued notes. Because of this burden, it is obliged to increase its shipments of coal, and therefore to extend its markets. To do this it is obliged to undersell other coal-shipping companies, and therefore to dispose of coal at prices that do not yield enough to pay the notes given coal producers and the notes given the railroad company. The coal producers must be paid; but such remaining funds as it can obtain can not pay the increasing mass of notes given the railroad company, which mature at shorter and shorter intervals. There is more juggling of notes through banks, and the mutual liability of the coal company and the railroad company rolls up, like a big snowball pushed by schoolboys. The coal company must stop business or its shipments must increase. To stop is to acknowledge its bankruptcy. To increase shipments necessitates still further expansion of markets. It builds docks at the places of market, and organizes another company to operate them.

Although the stock of this receiving company is controlled by the same men that control the stock of the shipping company, the shipping company sells coal to it, and takes notes of the receiving company in payment therefor. These notes the shipping company discounts at banks. Notes have therefore been given by the shipping company to the coal producers for coal, and notes for the same coal have been given the shipping company by the receiving company. But the shipping company and the receiving company are controlled by the same men, and neither have working capital. The notes can not be met. There is more juggling through the banks, and the snowball grows. The shipping company must sell coal; the receiving company must sell coal. They cut prices; their competitors cut prices to retain their trade. The cutting continues until the wages of the miners who dig coal are cut; they are cut and cut. Coal is piled up on the docks. A great panic sweeps over the country. The shutting down of mills

and factories diminishes the use of coal. The traffic of the railroads falls off, and their locomotives do not burn so much fuel. There is an oversupply of coal, and the miners, whose wages have been reduced to a starvation basis, are without work even at those wages. All of them are poor, and the most of them are ignorant of the remote sources of the wrongs that are undoing them. Their discontent grows, and they strike. Their children are without shoes, and their stomachs are empty. Their discontent gives rise to mutterings. Here a coal tipple is burned, there an operator mobbed. The operators employ deputy sheriffs to protect their property, and threaten to call on the Governor for the aid of the militia in preserving peace. The miners are whipped and return to work.

The railroad company and the shipping company and the receiving company push the growing snowball of their indebtedness before them. By juggling, twisting, scheming, and the manipulations through the banks they are kept afloat.

What finally happens? The railroad company, overburdened with debts, and robbed by its officers, goes into the hands of a receiver.

The great snowball of indebtedness rests upon the coal company; its notes are scattered far and wide in the banks that have discounted them. What can the banks do? Get judgment on the notes and take the property of the coal company. But the coal company owns next to nothing. Its docks are leased, its cars are leased, its coal land is leased; the lessors have the first claim, the banks would get nothing. What can the banks do? Allow the coal company to issue bonds, take bonds to the value of the notes which they hold, and allow the coal company to continue? If it has so lamentably failed in the past, what can be expected of the future? The banks are between the devil and the deep sea.

How did they get there? Because they discounted notes assuring the forthcoming of the result of human effort to the extent that the signers and indorsers failed to produce. Had the banks been fully alive to the conditions of the coal markets, they certainly would not, in the first place, have discounted notes covering supplies of coal that far exceeded the demand, and the sale of which affected the prosperity of other coal companies to such an extent that cutting of prices finally reacted upon the prosperity of every community concerned in the coal industry. But, if it be urged that it is asking too much of any bank to keep track of the intricacies of every business, that a bank is safe in discounting the notes of concerns that always pay their notes, there is the reply that these concerns did not pay their notes. By manipulation they apparently paid them, and therefore the sys-

tem under which such manipulation is possible is fundamentally wrong.

Under the Canadian banking system, with its large banks, each having enormous capital and branches throughout the Dominion, it is practicable to enforce the rule of "one concern, one bank"; each customer must render a confidential statement to his bank from time to time of the exact condition of his affairs, of his assets and liabilities, and it is to the interest of his bank to accord him the fullest accommodation that his business will justify. Its enormous resources enable it to thus accommodate all its customers. It is evident that under such a system such juggling as that instanced in the foregoing illustration could not have been carried on. Many of the banks of the United States have blank forms which they submit to offerers of paper for discount, the filling up of which completely discloses the condition of their affairs, the extent of their assets and liabilities in every shape and form. Had such statements been required of the coal company and the railroad company by each of the banks before discounting their notes, the possibility of ruin entailed by their reckless procedure would certainly have been averted; but men, shrewd, plausible, and unscrupulous, have a way of quieting the fears of banks and evading inquiries that are searching.

Under the Canadian system the few banks, each with large capital and many branches, find it to their interest to employ as managers men of character, foresight, and ability, and they are not allowed to participate in any way in the borrowing of money from their banks. In the United States each city has its numerous banks, no one of them firmly connected in management with any other bank. The officials often are men of minds not of the broadest and judgment not of the most accurate, who have attained their positions, perhaps, through influence of one kind or another, and sometimes they are in direct partnership with the men who have offered paper to the bank for discount, the recommendation of action upon which comes within their province.

Under the Canadian system there are restrictions upon the amounts which directors of a bank can borrow, and their heavy liability for losses incurred by their bank leads them to exercise much caution in accepting paper. In the United States many bank directors seek their positions almost exclusively because of the facilities they thereby obtain for borrowing, and by their accommodating each other the legitimate business of the bank and the community is prone to suffer.

Under the Canadian system there is an examiner for each large bank, who inspects its operations from time to time to ascertain not only that its status is sound from a bookkeeping and

arithmetical standpoint, but that it grants discounts on sound principles, and that the discounted paper held by it is good. In the United States there are national bank examiners, but their duties do not embrace a thorough and rigid scrutiny of the soundness of notes discounted.

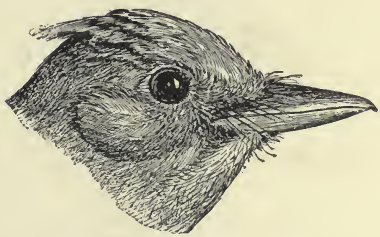
THE BIRDS AT DINNER.

By HARRIET E. RICHARDS.

WE think of the birds as dainty creatures, fit for poetry, song, and airy flights; but if we faithfully watch them a little, we shall discover that nearly their whole time and energy are devoted to securing their "daily bread."

Our familiar song birds begin their day about three in the morning; from that time until seven or eight in the evening the hours are mainly occupied in searching for food. Certainly they spend some time in making love, in building nests, in singing songs, but intermingled with it all is the constant demand for something to eat. Some fruit-eating birds are said to consume three times their own weight every day. Prof. Treadwell proved by experiment that a young robin will eat every day, and require

Head of Swallow. Natural size.



Crested Flycatcher. Natural size.

it too for perfect development, more than his own weight of animal food. Think of human beings eating at that rate! Gormandizers, indeed! Think, too, of the labor of providing for, say, four such hungry, greedy little ones!

Scientific investigation has proved that nearly all birds feed their young on insects, worms, or some form of animal food, and also depend mainly on such food for themselves at that busy period of their lives, although at other seasons their favorite food may be grains and berries. Dr. Brewer says a pair of jays feed their young five hundred thousand caterpillars in a season, and that they will destroy one million eggs each winter; and that a chickadee will largely exceed these figures.

There are several reasons why birds require so much food. They are active creatures, being almost constantly in motion, some individuals traveling many miles every day. Of all animals, their blood is the warmest; their temperature is about five de-

HAIRY WOODPECKER.
YELLOW-BELLIED SAPSUCKER.

grees higher than man's. This heat of the body is nicely protected by their covering of down and feathers, but it requires more food to make feathers than to make flesh or hair.

A tiny bird's body is a highly concentrated bit of nature, which is controlled by an intelligent and active brain that keeps his little system in such constant motion that it must be abun-

dantly nourished. If we notice carefully the beaks of all the birds we see, it will help us, by indicating their habits of feeding, to locate them in their families and thus lead us to their correct names. All the sparrows have short, stout beaks, well suited to cracking open seeds and grain, which is their usual food. The thrushes have a curved bill, convenient for holding worms and digging in the soil; they find most of their food on the gound, poking among the dead leaves and rubbish for grubs, beetles, and larvæ. Our robins, which are true thrushes, do valuable spring work in the garden and lawn pulling worms from the soil. Have you ever watched a robin at work? How he tugs and pulls when the worm is long and does not come easily! There is an

Ruby-throated Humming Bird (*Trochilus colubris*).

Golden-winged Warbler.

Red-eyed Vireo. Natural size.

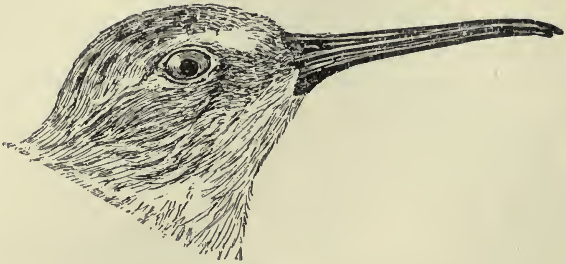
energy and a certain business air about him when at work which is very interesting.

The food of the thrushes is chiefly animal, although they like a few strawberries and cherries for dessert, which we ought to be very willing to allow them as a slight return for all the worms and insects they destroy for us. The warblers are almost exclusively insect-eating birds. A few of them hunt on the ground for their food, but as a family their place is high in the tree tops, searching among the foliage for the tiny insects, plant lice, and spiders that make their homes there. They are small birds, having slender beaks.

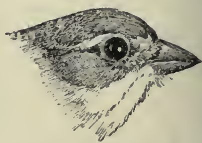
The tiny humming birds, with their long, needle-shaped bills, are well equipped for securing honey from the very heart of the trumpet flowers and honeysuckles. They find numerous small insects within the flower as well as honey. From a paragraph in a recent number of The Auk we might judge that spiders were a favorite food with them, a writer there telling us that he found

twelve spiders and many broken remnants of others in the gullet of a female humming bird that he dissected August 19, 1894. He remarks that "the gullet was also well filled with honey."

The swallows feed entirely on insects, securing them on the wing. To accomplish this successfully they are provided with



RED-BACKED SANDPIPER. Natural size.



CHIPPING SPARROW. Natural size.

broad, short bills and a mouth which opens very wide, really from eye to eye. The woodpeckers have large, chisel-like bills, which they put to constant use in securing their food, most of which they glean under dead bark on the trunks of trees. The tongues of the woodpeckers, excepting the sapsuckers, have little barbs on each side like the barbs of a fishhook; this little instrument, we may readily understand, proves very useful in capturing their prey. The sapsucker has a sort of brushlike arrangement at the end of the tongue which aids him in collecting his food. The woodpeckers feed mainly on insects, beetles, and grubs, and render us valuable service in destroying many pests; they also eat nuts and some fruit.

An interesting family of birds to observe when feeding are the flycatchers. Our kingbird is a familiar illustration of the family. They feed almost exclusively on insects in flight. They are cool-headed, businesslike birds, deciding to sit quietly on a perch until some pretty fly passes near; then, presto! a snap, and poor little fly is already in the flycatcher's gullet. There is no nervous uncertainty in a flycatcher's disposition, but quiet waiting till the decisive moment, then his sharp little bill clinches the winged creature in an instant.

Near my favorite window, on the branch of an apple tree, the tent caterpillars have had a nest for a number of years. I have never allowed the nest to be burned out or destroyed, choosing to leave it for a feeding place for the birds. It has been extremely interesting to notice the different birds around the nest, and their manner of attacking it. The yellow-throated vireos are the most frequent visitors; they find the worms a dainty feast. Often they thrust their tiny beaks into the sticky web and tear off bits

to take away for nest-building; sometimes it pulls hard, or they try to take too large a piece; then they will brace their feet, set their bodies, and tug with a vim; something has to give way, and very soon it is the sticky web; then away goes my yellow-throat, a happy conqueror.

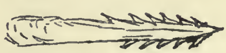
The orioles are the next most frequent visitors. They peck fearlessly into the nest; so do the little flycatchers—the chebecs. The yellow warblers, robins, redstarts, and rose-breasted grosbeaks, and, of course, numerous English sparrows peck around the foliage near the nest and try a worm occasionally that has crawled from the nest, but they do not often trouble the nest itself.

Nature plans very beautifully for her creatures. Every bird has its food within reach of its own well-directed effort; but it remains for the bird to make the effort and secure the food. The structure of the bird's body—his beak, feet, feathers, length of neck—his manner of flight, his habits, and tastes, all are nicely planned for the little owner's daily quest for food.

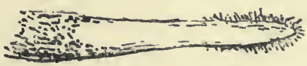
A humming bird would not enjoy a sparrow's chubby beak, neither would the grosbeak find it easy to open pea pods or pick potato bugs with the humming bird's needlelike bill. The shore birds—the sandpipers and herons—would find it difficult to scale the trunk of a tree for their dinner, as do the nuthatches and woodpeckers, but their long, slender beaks deftly pierce the mud for snakes and worms, while the ducks find their large, flat beaks convenient for seizing and holding a frog.

The nocturnal birds, as the owls and whip-poor-wills, each possess interesting physical characteristics for securing their food

Orchard Oriole. Im. ♂ second year; natural size.



Tongue of Woodpecker. Magnified.



Tongue of Sapsucker. Magnified.

in the dark. When we have learned the tastes and habits of any bird, we shall see how perfectly he is equipped with an apparatus that would be an incumbrance to some neighbor bird, but to him is indispensable to life and comfort.

If we will study something of the birds—their structure, their

habits, and their dispositions—we shall constantly be impressed with the practical wisdom of these little inhabitants of our gardens and forests, and be daily encouraged by their untiring industry and bright, sprightly ways.

SUGGESTION IN THERAPEUTICS.

By Prof. WILLIAM ROMAINE NEWBOLD.

IF there be any truth in the doctrines I have already put forth in these pages, it seems *a priori* probable that suggestion will prove useful in combating some of the many ills that flesh is heir to. The various devices for heightening suggestibility are simply devices for increasing the effects proper to any given mental state by removing from its path all obstacles. Among the effects of mental states are the production and prevention of other states and of movements, and there are many diseases which are characterized by disturbances of sensation, thought, or movement. Very often these disturbances are functional—that is, they can not be traced to any visible injury of the nervous system, and frequently appear and disappear in most unaccountable fashion. It does not seem improbable that in such cases suggestion might work effects worthy of serious consideration.

And in fact it does. Every physician knows that it does, even though he has never heard the word "suggestion," or laughs at the theories of Nancy. Instinctively every trained practitioner supports his remedies by suggestion, cheering the patient by word and look, pooh-poohing his fears, assuring him of a speedy recovery, and often, if he be somewhat wiser than common, expatiating upon the specific results expected from the dose now to be administered.

The movement known as Psychotherapeutics or Suggestive Therapeutics is an attempt to dissociate this element of medical practice from its concomitants in order to determine its value when taken by itself. What that value is I shall not venture to say. In all probability the advocates of the method—or some of them—exaggerate its efficacy, and doubtless the personality of the physician has much to do with its success. In one man's hands suggestion will work wonders; in those of another it is almost valueless. Yet the evidence is rapidly accumulating, and every year sees a greater consensus among those who have made the trial as to the limits within which it is of value.

I can not undertake in one short article to go into the details of the results reported by von Krafft-Ebing, von Schrenck-Notzing, Forel, Ladame, Moll, Wetterstrand, van Renterghem and

van Eeden, Liébeault, Bernheim, Janet, Bérillon, Pitres, de Jong, Bramwell, Lloyd Tuckey, Hamilton Osgood, and others, but I can say a few words as to the troubles in relieving which suggestion has been found useful.

In the first place, it will sometimes overcome insomnia. In the second, it has been used to restore to hysterical patients their lost sensations, but the restoration is usually but temporary. In the third, it may be used to destroy all sorts of disagreeable symptoms, especially neuralgic pains and headaches. It is possible to produce complete anæsthesia for surgical purposes in this way; but, as ether, chloroform, and cocaine are much more reliable, suggestion is seldom used. Dr. Wetterstrand, however, usually hypnotizes slightly before administering an anæsthetic; he has found that he can in this way get along with a much smaller amount of the drug, and also avoid the "violent" stage.

In the fourth place, suggestion is sometimes efficacious in cases of disordered ideation and morbid impulses. Mild melancholia, horror of food and of open spaces, insane doubt, homicidal and suicidal impulses, sexual perversion and inversion, dipsomania, morphinomania, fear of death, and others of the kind have been successfully treated by suggestion. But upon the more serious forms of mental disease it seldom has any effect.

In the fifth place, it is often of aid in motor disorders not dependent upon organic disease of the nervous system. Such are hysterical contractures, paralyses and convulsions, nervousness, chorea, sudden loss of voice, stammering, twitching of muscles, etc.

These are the troubles in which suggestion has been found most useful, but of course no one claims that it is a specific for them all. It often does good and never does harm; but sometimes it does no good, and at other times the improvement is but temporary. There is nothing very surprising in the fact that such troubles have sometimes been found amenable to suggestion. Although the effect ascribed to the mental state may be greater than we usually suppose such a state could produce, the difference is one of degree and not of kind. But I must now turn to a group of phenomena which seem at first glance to differ in kind as well as degree from anything with which we are familiar.

We usually conceive that the processes grouped under the word metabolism depend upon purely mechanical and chemical conditions, modified in some way, to be sure, by the fact that the body is alive and not dead, but still essentially physical and chemical. The word metabolism comes from a Greek word (*μεταβολή*) which means "exchange," and it designates the fact that

we suppose all the processes of nutrition and decay, secretion, assimilation, excretion, oxidation, etc., to be at bottom alike, and in the last analysis to consist in an exchange or substitution of atom for atom within the constituent molecules of the body.

Now, it is easily shown that this notion is erroneous, for the physical and chemical processes taking place within the body are not precisely like other such processes; they stand to some extent under the control of the nervous system. For example, the amount of heat evolved within the body is probably regulated by a center in the spinal cord. The nutrition of the voluntary muscles probably depends upon the functioning of certain cells in the anterior horns of the spinal cord, and if the latter are destroyed the muscles waste away. Dr. Darkschwitsch has recently published in the *Archiv für Psychiatrie* an elaborate study of certain forms of muscular atrophy complicated with painful disease of the joints. These frequently follow paralyses due to injury of the cortex, and he concludes that the metabolic changes probably result directly from the cortical injury and not from disuse of the affected limbs. I recollect seeing some time ago a patient of Dr. Charles K. Mills's who had had the left cortical center for the hand removed to cure an epilepsy. He had lost in consequence, as was to be expected, much of his power over the right arm and hand, and he had also lost, as was not to be expected, all the skin of his right hand. Dr. Mills told me he had several times seen localized metabolic disturbances follow lesion of that region of the cortex which controlled the muscles of the affected part.

Besides this probable direct control, the nervous system can affect metabolic processes indirectly through the blood supply. The distribution of the blood is regulated by the complex vasomotor mechanism which controls the force and rate of the heartbeat and the diameter of the arteries and arterioles; the entire system is controlled in turn by a center in the medulla. It acts for the most part reflexly, sending the blood tide with the greatest force to the organ that needs it most, but it can be affected in other ways.

Such facts are interesting, and they put it beyond question that the nervous system has to do with the processes of metabolism, but they do not show how those processes can be affected by the functioning of that part of the nervous system which underlies consciousness, or, to use my former phraseology, how mental states can control metabolism.

That some metabolic processes can be affected by mental states is well known. For example, the secretory and excretory processes can not only often be started and stopped in this way, but the chemical character of their products can be modified, as when

a sudden fit of anger makes a mother's milk poisonous to her child.*

In general, an emotional storm or even an emotional mood, if long continued, may have a profound effect upon the functioning of the body. The cheerful emotions favor health; the depressing emotions make the body fertile ground for the growth of disease germs. Yet even this admission does not bring one much nearer the point of interest; for, since the epoch-making discoveries of Prof. James, of Harvard, and Prof. Lange, of Copenhagen, it has been known that what we call an emotion is not the *cause* but the *feeling* of those extensive bodily changes which we regard as its expression, and to inquire into the effect of emotions upon metabolism would lead me too far afield into the general theory of emotion.

To account for the more remarkable effects of suggestion upon metabolism we are forced to a most extraordinary hypothesis, which may be thus stated:

The thought of any given bodily change, whether motor, vasomotor, or metabolic, tends to the actual production in the body of the change which that thought represents.

That this law is true of motor thoughts I think quite clearly proved. Of the vasomotor it is not so clearly true, but there is a considerable amount of evidence going to show that the blood tide can be to some extent directed by act of will by most persons, and by some persons to a much greater extent. The evidence for any control over the metabolic processes is very scanty. If the tendency exists, it must be latent in most persons, for we all know that I can not by thinking add a cubit to my stature or change the color of my beard. Yet, even though it be latent in most persons, it may exist in others, and I think the evidence for its existence is strong. The chief difficulty in accepting it lies in this: we know of no nervous mechanism by which such central processes can affect the body unless it be through the sensory nerves, and, according to our present physiology, sensory nerves can carry impulses in one direction only.

I can not explain these difficulties and shall not attempt to. I shall simply relate the more important bits of evidence which have been gathered since the 12th of May, 1885, when M. Focachon performed his first successful experiment under satisfactory conditions before the professors of the Medical School at Nancy. Most of this evidence is experimental and it deals with modifications of the skin only. I do not suppose that this fact proves that the control of thought over the skin is greater than that which it exercises over the internal organs, but merely that experiments

* Carpenter, Mental Physiology, § 566.

upon the skin are more satisfactory than those on other parts of the body, partly because their results are more manifest and partly because they are attended with less discomfort to the patient. They belong to two types: (1) those in which the modifications induced are chiefly vasomotor—redness, swelling, exudation of blood, etc.—but greater than one can usually produce by an act of will; and (2) those in which there is visible change in the tissue. It is quite possible that the latter are due in large part to vasomotor modifications, but we can not at present prove that such is the case. In connection with these experimental cases I shall introduce a few parallels derived from other sources to show their absolute identity of type.

The first case which I shall quote is reported by Dr. Biggs, of Lima, and is recorded by Mr. F. W. H. Myers in the Proceedings of the Society for Psychical Research, vol. vii, page 339. In three cases Dr. Biggs produced a red cross upon the skin by suggestion. His own account of the first of these cases, slightly abbreviated, is given as follows in a letter dated October 18, 1885:

"I put her into a magnetic or mesmeric sleep by laying my hand on her head for about a minute. I then said, 'Maria, do you hear me?' 'Yes.' 'Are you thoroughly magnetized?' 'Yes.' 'Now listen attentively: a cross is going to appear on your right forearm and remain there until I tell it to go away. Here is where it is to appear.' (I then described a cross with my forefinger on the inner side of her right forearm.) 'Have you understood what I have said to you?' 'Yes.' I then awakened her by two or three up-passes; for the next two or three days she seemed sulky and out of sorts, would now and then rub her right arm, over the place where the cross was to appear; when asked why she did this, she said there was an itching and she could not help scratching the place, although there was nothing to be seen that could cause the irritation. I then magnetized her as before, and asked, 'Do you recollect what I told you the other day about the cross that is to appear upon your arm?' 'Yes.' 'Will it appear?' 'Yes.' 'When?' 'In a few days.' 'Well, it must come out in three days; do you understand?' 'Yes.' By the time appointed a dusky red cross, four or five inches long and about three inches wide, made its appearance. At first we pretended not to notice this, although we could often see the lower part of it when her sleeve was partly rolled up in some of her duties in and about the house; she was our housemaid. It was only at intervals, when thrown into the magnetic sleep, that we could get a full view of the cross; never a word had been said to her about the cross in her waking moments, for some time, several weeks, until one day I pretended to have caught sight of the strange mark on her arm, and said:

'Why, Maria, what is the matter with your arm? Have you hurt it? What mark is this? Let me see; pull up your sleeve.' She did so with a slightly sulky, ashamed air. 'Why, it looks like a cross; where did you get this?' 'I don't know, sir.' 'How long has this been on your arm?' 'More than a month, sir.' 'Have you felt anything?' 'No, sir; only at one time I had a great deal of itching and burning, and a few days afterward this mark came out on my arm.' After this we frequently spoke to Maria about the cross, and when requested to she would roll up her sleeve and show it to visitors, although she always seemed reluctant to do so. Many months afterward she left our service, and in about two weeks she made her appearance at my office in town, asking me to remove the cross from her arm, as it attracted the notice of the family with whom she was now living, and she was much annoyed by the many questions asked her. I magnetized her, and then told her that the cross would disappear in a few days, and she would be no more troubled with it. I saw her a few days afterward at Salto; the cross had disappeared."

In another case Dr. Biggs caused a cross to appear every Friday on the chest for a period of nearly six months. These cases are not sufficiently well authenticated to make them of much value taken by themselves, but, in conjunction with the results got by other experimenters, they are worthy of consideration.

For example, Prof. Pierre Janet suggested to his hysterical patient Rose that he would put a mustard plaster upon her abdomen to relieve hysterical contractures of the stomach. "I found, some hours later," he says,* "a swollen mark, dark red in color, in the form of an elongated rectangle, but—odd detail—none of its angles were clearly marked, for they seemed neatly cut off. I remarked that the burn had an odd shape. 'Don't you know,' said she, 'that the corners of the Rigollot plasters are always cut off so that they won't hurt?'" Following up this hint, Prof. Janet suggested putting on a plaster shaped like a six-pointed star, and he got the corresponding burn. On the chest of another patient he produced an S in the same way. Prof. von Krafft-Ebing has done the same with his famous patient Ilma Szandor.†

Prof. Charcot's case of suggested œdema is even more curious, as it involved not merely vasomotor changes, but also a fall of temperature, and probably modified nutrition as well. It is reported by Dr. Levaillain.‡ "M. Charcot had presented two cases

* L'Automatisme Psychologique, p. 166.

† Eine experimentelle Studie auf dem Gebiet des Hypnotismus. Stuttgart, 1889. English translation by C. G. Chaddock, M. D., New York, 1889.

‡ Revue de l'Hypnotisme, vol. iv, p. 354, June, 1890. Cf. also Mr. Myers, *op. cit.*, p. 337.

of hysterical blue œdema occupying the entire extremity of the upper limb and making the hands appear swollen, bluish, cold, contrasting in the highest degree in volume, temperature, and coloring with the hand of the opposite side. He then exhibited in the auditorium a patient suffering from major hysteria who was hypnotizable. The following suggestions had been given her during the hypnotic sleep for four or five days: She was told her right hand was puffing out, becoming larger than the other; that it was getting blue, becoming red, then violet; finally, that it was hard and was getting colder and colder. Under the influence of these suggestions, repeated at five or six hypnotic sittings, the right hand became enormous very rapidly, almost double the volume of the other; it was really much discolored and of a true cyanic tint; it was hard to the touch, and the finger would not sink into it; finally, its temperature was three degrees (centigrade) below the normal temperature of the rest of the body. In a word, it resembled in every respect the hand of another hysteric who was suffering from a spontaneous blue œdema. It was, then, possible to produce and localize in the hand by means of simple suggestions lasting disorders of nutrition and circulation of such a character that the hand became half again as large, more colored, and much colder than the other hand."

Another curious vasomotor phenomenon is the "bloody sweat." It is sometimes found occurring spontaneously without visible reference to mental states. Such a case is reported by Dr. Ernoul, of St. Malo.* A hysterical girl whom he observed had bleeding spots on various parts of her body which appeared and disappeared in most unaccountable fashion. A somewhat similar case was observed by Drs. Artigalas and Rémond,† in which the bleeding could be produced by suggestion. The patient was a young married woman, twenty-two years of age. She entered the hospital October 31, 1891, for various troubles requiring surgical treatment. Later she complained of pain in the ears, and had several hæmorrhages from them. On the 23d of November and the seven subsequent days she at times wept bloody tears. She called the doctors' attention to this on the 27th; they could find no injury in the eye, but learned that she had had in childhood frequent hæmorrhages from the nose and one from the stomach. A careful examination showed many hysterical symptoms. She was hypnotized, but it was not possible to check the bloody tears by direct suggestion; they could, however, be occasioned by suggestion at any time. "On December 1st, Prof. Artigalas put her again to sleep, and suggested to her that the hæmorrhages from the eye would not recur, but that she would bleed from the hollow

* Revue de l'Hypnotisme, iv, 283.

† *Op. cit.*, vi, 250.

of the left hand. A few minutes after being awakened she in fact had a hæmorrhage, or rather a bloody sweat, on the palm of the left hand. The phenomenon took place under our eyes without M. Artigalas leaving the patient and without any possibility of fraud. The skin was absolutely sound on the surface at the point which bled; the blood seemed to exude in the creases much as a profuse sweat would have done; one could not detect upon trial any appreciable modification of the integument. The hæmorrhage ceased upon washing the hand in cold water." The palmar hæmorrhages were then checked by suggestion.

Drs. Bourru, Burot, and Mabille have got even more curious phenomena in the case of their famous hysterical patient, Louis V——. They produced bleeding by suggestion from the nose, from designated points on the skin, and even fixed beforehand the hours at which the bleeding was to take place. On one occasion they heard him *give himself*, while in a secondary state, similar suggestions, and the blood appeared punctually on the spot indicated. Nothing could better demonstrate the subjective character of the agency that produces these inexplicable results.

These cases are precisely parallel to those of the so-called "stigmatics"—"saints" who bore upon their persons the marks of crucifixion. The hagiology of the Roman Catholic Church is full of them, and not a few have been observed in recent years. I will quote the case of one: Marie de Moerl, of Kaldern, in the Tyrol, became subject to ecstasy in 1832, she being then about twenty years of age. Generally the subject of her meditation was the passion of Jesus. "In the autumn of the same year her confessor perceived that the palms of her hands, where subsequently the marks of the crucifixion appeared, sank in, as if under the pressure of a body in half relief. At the same time the part became painful and frequently cramped. On the 2d of February, 1834, at the Feast of the Purification, he observed her wipe the middle of her hands with a towel and exhibit a childlike alarm at the blood which she perceived there. These marks soon showed themselves on her feet and her heart. They were nearly round, spreading a little in length, three or four lines in diameter, and seeming to pass through both hands and both feet. On Thursday night and Friday all these wounds shed drops of blood, ordinarily clear. On other evenings they were covered with a crust of dried blood." *

The well-known case of Louise Lateau was precisely similar. At the present time, according to newspaper accounts, a certain Mrs. Stuckenborg, of Louisville, Ky., presents the phenomena of

* Brierre de Boismont, Hallucinations, Case 100. English translation, Philadelphia, 1853.

stigmatization. Dr. Hodgson told me he went to Louisville and endeavored to study the case, but found she was in the hands of the Roman Catholic authorities, and he was not allowed to examine her.

The ease with which warts can be "charmed away" by suggestion has long been known. I will quote two cases. The patient in the first case was my wife, then a little girl, and the account was written for me by her mother. "I remember it all perfectly. It was when E—— was about six years old, just before we went to Boston to live. She had had warts on her hands for over a year. They had spread until her hand was not only badly disfigured, but very painful, as they were apt to crack and bleed. Two physicians, both relatives of ours, had prescribed for them, and we had followed directions without success. We were in Lawrence, at M. P——'s. A lady came to tea, noticed the warts, and offered to remove them by a 'charm.' As I had once or twice been relieved in childhood in the same way, I was delighted at the offer. She went through some mummery, rubbing them and muttering something, I think, and then announced that they would be gone in a month. They were, every one. In a few days they began to dry up and disappear. So far as I can remember, she never had another. When I was a child there was a neighbor of ours who used to remove all the warts in the neighborhood. I never heard of his failing, and I know of many successful removals in our own family. He used a piece of thread. He would tie it around the wart—if he could—with great solemnity, rub it three times, and very carefully put the piece of thread in a paper in his pocketbook. This made a very great impression on us, I remember. It seemed next to a church service, having your wart taken off."

Dr. Bonjean, of Lausanne, in a letter to the *Revue de l'Hypnotisme*, dated March 3, 1896, tells an interesting story of the same sort. An old lady, a relative of his, had long had the reputation of being able to remove warts, and he had himself been cured by her of a very bad one. Her method was to bandage the eyes of the patient and instruct him not to touch the wart or disturb the bandage while she was operating. Her daughter then entered and touched the wart with an object (described by Dr. Bonjean) which could not have had any curative power. The warts disappeared in from one to three weeks. When the old lady died, Dr. Bonjean learned her secret. He saw clearly that her success must be due to suggestion, and he undertook to cure warts without the use of the object upon which she relied, but imitating her methods in other respects. He never hypnotizes the patient, and says he thinks it is only important to impress him deeply with the notion that the warts will go away.

Among the most extraordinary and best authenticated cases of suggested modification of the metabolic processes are those in which burns have been so produced. The first of these was, I believe, produced by M. Focachon, an apothecary of Charmes, in France, on a patient named Elisa F—— He succeeded in doing it several times, and the details can be found in Prof. Beaunis's *Le Somnambulisme provoqué*, pages 72–84. I will describe one or two. On the 12th of May, 1885, at 11 A. M., she was hypnotized, and eight postage stamps were placed on her left shoulder, with the suggestion that a blister was being applied. She was then watched and kept asleep. At 8.15 A. M. next day, she was examined in the presence of MM. Bernheim, Liégeois, Liébeault, Beaunis, and others, and the bandages were removed. All were satisfied that they had not been disturbed. "Within an area of about four by five centimetres the epidermis was found thickened and deadened, of a yellowish color, but it was not raised and had not formed blisters. It was thickened, a little wrinkled, and in a word presented the appearance of the period which immediately precedes true blistering, with the formation of fluid. This region was surrounded by a zone of intense redness, with swelling about half a centimetre in extent." A year later M. Focachon succeeded in neutralizing the effect of a Spanish fly blister on the same patient.* One piece was put on the left forearm and the other on the corresponding region of the other arm. She was hypnotized and told that the one on the left arm would not burn her. She was then watched nine hours and a half and examined. The left arm was almost absolutely unaffected; on the right a blister was forming. The bandages were replaced for forty-five minutes and then examined again. On the right arm was a blister from which a serous fluid was got; the left was intact.

Another such case was reported by Dr. J. Rybalkin, of the Hôpital Marie in St. Petersburg.† The patient, a house painter, sixteen years of age, was hypnotized at 8.30 A. M., and was told he would burn himself on the arm by touching a stove—in which, by the way, there was no fire. He uttered a cry of pain when he touched it, and within a few minutes a red, painful mark appeared on the arm. The physicians then watched this develop into a complete burn. By 10 A. M. next day blisters had developed, these formed a scab, and the wound healed as an ordinary burn would have done.

With such extensive control of the metabolic processes of the skin experimentally demonstrated, it is not surprising to meet with remarkable cures of skin diseases. Thus Dr. Hamilton Os-

* Liégeois, De la Suggestion, § 278.

† Cf. Revue de l'Hypnotisme, iv, 361, and Myers, *op. cit.*, 338.

good, of Boston,* reports four cases of eczema and one of dermatitis cured or improved by suggestion. One, for example, was that of a boy of eleven, who had suffered from eczema since he was eighteen months old; his body was nearly covered by the eruption and consequent scabs, and the itching was intolerable. He had been treated by many dermatologists without the least success. Dr. Osgood hypnotized him and told him the itching would cease and the skin would become sound. The itching was immediately relieved, and the eruption was nearly gone in a fortnight and quite gone in a month.

The most extraordinary case of the kind, however, that I have yet seen comes from Moscow, and is vouched for by Prof. Kozhevnikoff, the most eminent neurologist of Russia. The account which I transcribe is from the British Medical Journal, November 16, 1895.†

"A 'miraculous' cure has recently occurred in Moscow, where it has caused considerable excitement. It is perhaps a more than usually interesting instance, and therefore deserving of the permanent record given to it by Prof. Kozhevnikoff, who gave the details of the case at the last meeting of the Society of Neuro-Pathologists in Moscow. The professor had not had the patient under his treatment, but had seen him more than once both before and after the 'cure.' The patient, N—— D——, was a lecturer in the Moscow University. He had suffered from a severe form of *sycosis menti* since June, 1894, for which he underwent treatment at the hands of various specialists—among others, of Profs. Kaposi, of Vienna; Schwimmer, of Buda-Pesth; Lassar, of Berlin; Pospiélof, of Moscow; and Stukovenkof, of Kief. In April last he returned to Moscow. His chin was then covered with a freely suppurating eruption. He now sought the advice of a 'wise woman,' an attendant at the baths, who was in the habit of giving herbs and 'simples' to her clients. In this case no such remedy was employed. N—— D—— was told to meet the woman next morning at five o'clock in the Temple of the Saviour, the colossal church on the Moskva River, which has been building all the century and is yet incomplete, in memory of the famous events of 1812. He came as told, and while he remained a passive onlooker, the woman prayed for three or four minutes; the same thing was repeated that evening and again the following morning. But in the meantime the eruption of N—— D——'s face had begun to improve; the discharge ceased, the swelling subsided, and in twenty-four hours scarcely a sign of disease was left. Such are the facts as given by the patient himself, and confirmed by Prof. Kozhevni-

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* Revue de l'Hypnotisme, ix, 300.

† See a more complete account in the Revue de l'Hypnotisme, January, 1896.

koff. The professor, however, adds some important points bearing upon the case: The patient is of neurotic temperament; his sister is highly hysterical; he had frequently had boils on both arms with a marked tendency to symmetry in position; and the *sycosis* itself showed some signs of being, if not of nervous origin, at least under nervous influence. The impressive surroundings under which the 'cure' was wrought, and the mysterious cabalistic prayer—which the woman refused to divulge, lest it should begin to act with the person to whom she told it and cease to act with herself—are also factors to be remembered in connection with the neurotic and impressionable character of the patient."

I might extend this catalogue almost indefinitely, but my space is limited. What shall we say of these facts? It is evident that they can not be explained by our present psycho-physiological theories, and many other attempts at explanation have been offered. The Roman Catholic ascribes them to the supernatural intervention of the Virgin or saints; the evangelical Christian sees in them the power of God, and an attempt has been made in recent years by the "faith healers" to make them an essential part of an evangelical creed in which "faith" is the divinely ordained instrument, not merely for the purification of the soul from sin, but for the deliverance of the body from disease as well. The self-styled "Christian scientists" and "metaphysical healers" approach the question from a pseudo-idealistic point of view. Mind, say they, is the only reality; things are nothing but very stable thoughts; the body exists only because the soul thinks it; disease is therefore merely a pernicious fixed idea: abolish the idea, and the disease is *ipso facto* abolished.

It is impossible for any one who has been trained in the study of natural phenomena to revert to such crude theories as these. The "scientific" man, to whom nothing is intelligible unless it is capable of interpretation in the mechanical conceptions of our latter-day atomism, usually finds it simpler to deny all facts which he cannot at once bring under those conceptions. He forgets that experience is the only test of truth, that our scientific conceptions are merely the tools which the human mind has devised in order to grapple with the infinite manifold of experience. They are good tools. They are as much better than the animistic conceptions of primitive man as our modern machinery is better than his axes and chisels of stone; yet our mental as well as our material tools can be improved. There are, I believe, engineering feats which our present appliances can not accomplish, and there are also, I believe, phenomena of Nature which our present conceptions are insufficient to explain. Yet I would not pronounce the former impossible or the latter essentially unintelligible.

CAUSES, STAGES, AND TIME OF THE ICE AGE.

By WARREN UPHAM.

IF we could see the entire earth at once, by some grand extension of our range of vision, as we might walk around a geographic globe a hundred feet in diameter, and examine it fully, with comparison of all portions of its area, probably no other features of the great terrestrial panorama would be so impressive as the wonderful diversity of climatic conditions. At the same time with perpetual summer on the equator and throughout nearly all of the intertropical zone, a wintry covering of snow and ice would be seen on all lands in high latitudes about one or the other pole. While every bounty of luxuriant plant and animal life is present to attract the traveler and furnish him sustenance in the central zone, the rigorous climate which is gradually encountered in approaching the poles, and the general decrease and limitation of both flora and funa, have opposed insuperable obstacles to the most eager and courageous explorers. About four hundred and fifty miles at the north, and about eight hundred and fifty miles at the south, lie beyond the farthest limits of exploration; and more than double these distances must be crossed, respectively, if one would pass, according to Nansen's hope and plan, from one side to the other of the hitherto untraversed circumpolar areas.

During the Ice age, or Glacial period of geology, very extensive and thick sheets of land ice, like those now enveloping the Antarctic continent and the interior of Greenland, overspread the northern half of North America (excepting the greater part of Alaska) and northern Europe, with nearly the whole of the British Isles. The southern boundary of the North American ice sheet crossed Nantucket and Martha's Vineyard, Block Island, Long Island, and Staten Island. On the mainland it extended through northern New Jersey and northeastern and northwestern Pennsylvania, being indented by a great angle, whose apex was at Salamanca in southwestern New York. Thence it reached southwest and west across southern Ohio, Indiana, and Illinois, and through central Missouri, into northeastern Kansas; and beyond, it curved far northward, crossing eastern Nebraska and South and North Dakota. From near Bismarck it again trended westward through Montana, Idaho, and Washington, to the Pacific Ocean not far south of Puget Sound. North of this line an area of about four million square miles, stretching to the Arctic archipelago, was covered with ice hundreds and thousands of feet deep.

The comparatively small present ice sheet of Greenland covers

five hundred and seventy-five thousand square miles,* and rises with average slopes of one hundred feet or more per mile to a central height, along its axial portion, of eight to ten thousand feet, or almost two miles measured vertically, above the sea level. The ancient ice sheets had a similar altitude and thickness. From the directions of outflow of the North American ice fields, as shown by the transportation of the glacial drift, and from the observed upper limits of glaciation on high mountains, Prof. James D. Dana estimated the thickness of the ice formerly accumulated above the Laurentide highlands, between the St. Lawrence River and Hudson Bay, to be fully two miles. It probably varied in thickness from one to two miles across Labrador, the Laurentide highlands, James Bay, Lake Winnipeg, Reindeer and Athabasca lakes, to the Rocky Mountains, in the region of the Peace River, where their summits, lower than southward, were probably buried beneath the ice expanse. In British Columbia, according to Dr. George M. Dawson's observations of glacial striæ and drift on mountains, the ice sheet exceeded a mile in depth.

In all directions from its thick central areas the vast continental glacier flowed outward, carrying its drift from Hudson Strait, Labrador, and Newfoundland easterly beyond the present coast line; from the provinces of Quebec and Ontario southeasterly across New England, and southerly and southwesterly across the basins of the Laurentian lakes; from Manitoba and the Saskatchewan region southerly into Minnesota, Iowa, the Dakotas, and Montana; from British Columbia into Idaho and Washington on the south, into the edge of the Pacific Ocean on the west, and down the Yukon Valley on the north; and from the great northern Barren Grounds northerly down the Mackenzie and across the islands of the Arctic Sea.

Northern Europe and the present basins of the Irish, North, Baltic, and White Seas were covered by an ice sheet which attained an extent of two million square miles, being half as large as that of North America; and its maximum depth above Sweden and the beds of the Baltic Sea and Gulf of Bothnia was one mile, or more probably two miles. The high, much eroded, and channeled Scandinavian plateau even now has numerous local ice fields, varying in size up to five hundred square miles, which are doubtless remnants of a continuous glaciation through all the centuries since the vast European ice field of the Glacial period

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* Measured on a map drafted by the author for Greenland Icefields, by Prof. G. Frederick Wright and Warren Upham (D. Appleton & Co., 1896). From my chapters in this book some later paragraphs of the present paper are derived, with condensation and rearrangement.

flowed outward on all sides from this great plateau. Bowlders from its rock formations were then borne by the slow glacial currents eastward to the head waters of the Volga, southward to the Dnieper and the Rhine, and southwestward to the northeastern shore of England, where the confluent current of the ice flowing away from the Scottish Highlands warded off the Scandinavian ice after its passage over the bed of the shallow North Sea. The European ice sheet extended south only to the latitude of 50°, while that of our continent reached to 38° in southern Illinois; but the difference was similar to the present contrast of the mean annual temperature and isothermal lines of the two continents.

To-day the Greenland ice sheet, the Malaspina ice sheet between Mount St. Elias and the ocean, many glaciers southward along the Cordilleran mountain belt, and the ice fields and glaciers of Norway and the Alps, may be regarded as lingering representatives of the conditions of the Glacial period, which not long ago, geologically speaking, spread a white pall of snow and uninhabitable desolation over large parts of the earth that are now temperate, fruitful, and populous. The returning mild and habitable conditions, with luxuriant plant and animal life, are like the average of long geologic eras which preceded the Ice age, and were of far greater and indeed almost inconceivable duration. The severely cold and snowy Glacial climate of extensive land areas was wholly unlike their mild or even hot climates during the very long Tertiary and Mesozoic eras, of which we find testimony in their fossil floras and faunas. Palms allied to those of the tropics, and sequoias closely related to the big redwood trees of California, grew during Tertiary times in Greenland, Spitzbergen, and the New Siberia Islands. Baron Nordenskjöld, after examining thousands of miles of arctic shore lines, with frequent clearly exposed geologic sections belonging to the periods extending back from the Ice age through the Tertiary or Cenozoic, the Mesozoic, and the Palæozoic eras, affirmed that he nowhere discovered any evidence of glaciation previous to the Pleistocene period, which followed the Tertiary and introduced the Quaternary era.

Latest in the great series of periods made known by the geologic record, the Pleistocene or Glacial period stands alone and unique, unless we must also recognize a general prevalence of glacial conditions at or near the end of the Palæozoic era. Bowlder-bearing deposits which can be explained only as glacial drift, and striation of the underlying rock which testifies unmistakably of the action of great glaciers or sheets of land ice, are found in the Carboniferous or the Permian series, closing the Palæozoic system, in Britain, France, and Germany, Natal, India, and southeastern Australia. In Natal the striated glacier floor is in latitude

30° south, and in India only 20° north, of the equator. Such evidences of late Palæozoic glaciation are also very clearly exhibited on the Varanger Fiord, in the extreme northern part of Norway, beyond the Arctic Circle. During all the earth's history before the Ice age of Pleistocene time, no other such distinct indications of general or interrupted and alternating glaciation have been found. Geologic exploration reveals only these two glacial periods, and they are separated in time by the vast Mesozoic and Tertiary eras, together estimated by Dana and others to comprise some ten to fifteen or twenty million years.

It is especially suggestive, in our inquiry concerning the causes of the Ice age, that both the Palæozoic and the Quaternary glacial periods were characterized by very unusual and exceptional oscillations in the height of continental areas and by the formation or renewed uplifting of great mountain ranges. Epochs in which certain mountain belts came into existence, or, after being partly or chiefly worn away, were restored by great uplifts, have alternated with far longer periods and eras of comparative repose. Between the epochs of mountain-building, the slow wearing and gnawing of rain, frost, and chemical decay have striven to carry away the mountains to the plains and the sea. At two times of the birth or rejuvenation of the grandest mountain chains of the world, with the most remarkable upward and downward movements of continents, the accumulation of glaciers and ice sheets has been closely associated.

Each of these periods of mountain formation, continental uplifts, and widespread glaciation was geologically short; but they were separated by a lapse of time so long that it can be adequately imagined only through the aid of a mathematical or geometric illustration on an almost infinitely reduced scale. Let the duration of a lifetime of seventy years be represented by a span, or nine inches. A century on this scale will be denoted by a foot, a thousand years by ten feet, and a million years by about two miles. The whole duration of the earth's existence since the beginning of life upon its surface, if between fifty and a hundred million years, as estimated by Dana, Walcott, and others, would then be represented by a distance of about one hundred, one hundred and fifty, or two hundred miles. In accordance with the probable ratios of the several great eras of geology, which are determined through comparisons of their thicknesses of sedimentary rocks and their progress in evolutionary changes of faunas and floras, we may place the Palæozoic glacial period at a distance of twenty to forty miles back from the present day, corresponding to some ten to twenty million years. That glacial period may have been no longer than the Ice age recently ended—that is, twenty-five thousand to fifty thousand years, more or less. The

ice ages, therefore, would be marked by a length of some two hundred and fifty to five hundred feet for each on the assumed scale, and they would be separated by an interval approximately two hundred or four hundred times as long, according to the range in the estimates of the length of the intervening Mesozoic and Tertiary eras.

The chief astronomic theories of the causes of glaciation, proposed by Dr. James Croll and General A. W. Drayson, would require the frequent recurrence of glacial epochs during all the vast interval dividing the two times of actual widely extended glaciation of which geology bears record. It seems quite certain, therefore, that we must look rather to unusual conditions of the earth itself than to its astronomic relations as the causes of the Ice age.

Another theory, which supposes changes in the earth's attitude toward the sun, is the suggestion, first made in 1866 by Sir John Evans, that, while the earth's axis probably remained unchanged in its direction, a comparatively thin crust of the earth may have gradually slipped as a whole upon the much larger nucleal mass, so that the locations of the poles upon the crust have been changed, and that the Glacial period may have been due to such a slipping or transfer by which the regions that became ice-covered were brought very near to the poles. The same or a very similar view has been recently advocated by Dr. Fridtjof Nansen, who writes: *

> The easiest method of explaining a Glacial epoch, as well as the occurrence of warmer climates in one latitude or another, is to imagine a slight change in the geographical position of the earth's axis. If, for instance, we could move the north pole down to some point near the west coast of Greenland, between 60° and 65° north latitude, we could, no doubt, produce a Glacial period both in Europe and America.

Very small changes of latitude which had been detected at astronomical observatories in England, Germany, Russia, and the United States, seemed to give some foundation for this theory, which in 1891 was regarded by a few American glacialists as worthy of attention and of special investigation by astronomers, with temporary establishment of new observatories for this purpose on a longitude about 180° from Greenwich or from Washington. During the year 1892, however, the brilliant discoveries by Dr. S. C. Chandler of the periods and amounts of the observed variations of latitude, showing them to be in two cycles respectively of twelve and fourteen months, with no appreciable secular change, forbade reliance on this condition as a cause or even as an element among the causes of the Ice age. This theory is now entirely out of the field. Sir Robert S. Ball, after reviewing Dr.

* The First Crossing of Greenland (1890), vol. ii, p. 454.

Chandler's investigations, estimates that the place of the pole since the Glacial period, and from even earlier geologic times, has been without greater changes of position than would lie inside the area of a block or square inclosed by the intersecting streets of a city.

We come now to the wholly terrestrial or geologic theory of the causes of the Ice age, which in terms varying with increasing knowledge has been successively advocated by Lyell, Dana, Le Conte, Wright, and the present writer. According to this explanation, the accumulation of the ice sheets was due to uplifts of the land as extensive high plateaus receiving snowfall throughout the year. Geology has received from Gilbert, in his monograph on Lake Bonneville for the United States Geological Survey, the terms *epeirogeny* and *epeirogenic* (continent-producing), to designate the broad movements of uplift and subsidence which affect the whole or large portions of continental areas or of the oceanic basins. This view, accounting for glaciation by high altitude, may therefore be very properly named the *epeirogenic theory*. It is adversely criticised by Prof. James Geikie, who calls it "the earth-movement hypothesis."

So early as 1830 Lyell pointed out the intimate dependence of climate upon the distribution of areas of land and water and upon the altitude of the land. In 1855 Dana, reasoning from the prevalence of fiords in all glaciated regions, and showing that these are valleys eroded by streams during a formerly greater elevation of the land previous to glaciation, and from the marine beds of the St. Lawrence Valley and basin of Lake Champlain belonging to the time immediately following the glaciation, announced that the formation of the drift in North America was attended by three great continental movements: the first upward, during which the ice sheet was accumulated on the land; the second downward, when the ice sheet was melted away; and the third, within recent time, a re-elevation, bringing the land to its present height. But with the moderate depth of the fiords and submarine valleys then known, the amount of preglacial elevation which could be thus affirmed was evidently too little to be an adequate cause for the cold and snowy climate producing the ice sheet. The belief that this uplift was three thousand feet or more, giving sufficiently cool climate, as Prof. T. G. Bonney has shown, to cause the ice accumulation, has been only reached within the past ten years through the discovery, by soundings of the United States Coast Survey, that on both the Atlantic and Pacific coasts of the United States submarine valleys evidently eroded in late Tertiary and Quaternary time reached to profound depths, two thousand to three thousand feet below the present sea level.

The continuation of the Hudson River Valley has been traced by detailed hydrographic surveys to the edge of the steep continental slope at a distance of about one hundred and five miles from Sandy Hook. Its outermost twenty-five miles are a submarine fiord three miles wide and from 900 to 2,250 feet in vertical depth measured from the crest of its banks, which with the adjoining flat area decline from three hundred to six hundred feet below the present sea level. The deepest sounding in this fiord is 2,844 feet. An unfinished survey by soundings off the mouth of Delaware Bay finds a similar valley submerged nearly twelve hundred feet, but not yet traced to the margin of the continental plateau. Again, the United States Coast Survey and British Admiralty charts, as Spencer states, record submerged fiord outlets from the Gulf of Maine, the Gulf of St. Lawrence, and Hudson Bay, respectively 2,664 feet, 3,666 feet, and 2,040 feet below sea level. The bed of the old Laurentian River, as the preglacial St. Lawrence is named by Spencer, from the outer boundary of the Fishing Banks to the mouth of the Saguenay, a distance of more than eight hundred miles, is reached by soundings 1,878 to 1,104 feet in depth. Advancing inland, the sublime Saguenay fiord along an extent of about fifty miles ranges from three hundred to eight hundred and forty feet in depth below the sea level, while in some places its bordering cliffs, one to one and a half miles apart, rise abruptly fifteen hundred feet above the water.

On the Pacific coast of the United States Prof. Joseph Le Conte has shown that the islands south of Santa Barbara and Los Angeles, now separated from the mainland and from each other by channels twenty to thirty miles wide and six hundred to one thousand feet deep, were still a part of the mainland during the late Pliocene and early Quaternary periods. In northern California Prof. George Davidson, of the Coast Survey, reports three submarine valleys about twenty-five, twelve, and six miles south of Cape Mendocino, sinking respectively to 2,400, 3,120, and 2,700 feet below the sea level, where they cross the hundred-fathom line of the marginal plateau. If the land there were to rise one thousand feet, these valleys would be fiords, with sides towering high above the water, but still descending beneath it to profound depths. Le Conte has correlated the great epeirogenic uplifts of North America, known by these deeply submerged valleys on both the eastern and western coasts, with the latest time of orogenic disturbance by faulting and upheaval of the Sierra Nevada and Coast Range in California during the closing stage of the Tertiary and the early part of the Quaternary era, culminating in the Glacial period. In the Mississippi basin, from the evidence of river currents much stronger than now, transporting Archæan

pebbles from near the sources of the Mississippi to the shore of the Gulf of Mexico, Prof. E. W. Hilgard thinks that the preglacial uplift, inaugurating the Ice age, was four thousand or five thousand feet more in the central part of the continent than at this river's mouth.

Although the adequacy of the preglacial epeirogenic elevation of this continent to produce its Pleistocene ice sheet was tardily recognized, it was distinctly claimed by Dana in 1870 that the Champlain subsidence of the land beneath its ice load, supposing it to have been previously at a high altitude, must have brought climatic conditions under which the ice would very rapidly disappear. The depression would be like coming from Greenland to southern Canada and New England. In Prof. Dana's words: "Such an extended change of climate over the glacier area was equivalent in effect to a transfer from a cold, icy region to that of a temperate climate and melting sun. The melting would therefore have gone forward over vast surfaces at once, wide in latitude as well as longitude."

Such explanations as these, accounting for the gradual accumulation and comparatively rapid dissolution of the North American ice sheet, are also found to be applicable to the ice sheets of other regions. The fiords of the northern portions of the British Isles and of Scandinavia show that the drift-bearing northwestern part of Europe stood in preglacial time one thousand to four thousand feet higher than now; while, on the other hand, late glacial marine beds and strand lines of sea erosion testify that when the ice disappeared the land on which it had lain was depressed one hundred to six hundred feet below its present height, or nearly to the same amount as the Champlain depression in North America. Mr. T. F. Jamieson appears to have been the first in Great Britain or Europe to attribute the ice accumulation to altitude of the land, and to hold the view (which I receive from him) that the submergence of glaciated lands, when they were loaded with ice, was caused directly by this load pressing down the earth's crust upon its fused interior, and that the subsequent re-elevation was a hydrostatic uplifting of the crust by underflow of the inner mass when the ice was melted away. Just the same evidences of abundant and deep fiords and of marine beds overlying the glacial drift to heights of several hundred feet above the sea are found in Patagonia, as described by Darwin and Agassiz. On these three continental areas the widely separated chief drift-bearing regions of the earth are found to have experienced in connection with their glaciation in each case three great epeirogenic movements of similar character and sequence—first, a comparatively long-continued uplift, which in its culmination appears to have given a high plateau

climate with abundant snowfall, forming an ice sheet whose duration extended until the land sank somewhat lower than now, leading to amelioration of the climate and the departure of the ice, followed by re-elevation to the present level. The coincidence of these great earth movements with glaciation naturally leads to the conviction that they were the direct and sufficient cause of the ice sheets and of their disappearance; and this conclusion is confirmed by the insufficiency and failure of the other theories which have been advanced to account for the Ice age.

The end of the Tertiary era and the subsequent Glacial period were exceptionally characterized by many great oscillations of continental and insular land areas. Where movements of land elevation took place in high latitudes, either north or south, which received abundant precipitation of moisture, ice sheets were formed; and the weight of these ice sheets seems to have been a chief cause, and often probably the only cause, of the subsidence of these lands and the disappearance of their ice.

The general contemporaneousness of the Glacial period on the opposite sides of the North Atlantic Ocean had been long accepted as probable, but its demonstration and the identification of the corresponding parts of the Ice age, having the same sequence on the two continents, were first made known less than two years ago by the studies of Geikie and Chamberlin in the new third edition of The Great Ice Age, and by their later papers in the Journal of Geology. According to the subdivision recognized by these authors, the time of principal accumulation of marginal moraines is regarded as an epoch distinct from the previous portions of the Ice age; and Chamberlin has named the earlier divisions of this period, when the North American ice sheet reached its culmination, the Kansan and Iowan stages, while the later moraine-forming time is called the Wisconsin stage, from the magnificent development of the moraines in eastern Wisconsin. Between these glacial stages, which appear well recognizable and synchronous in North America and Europe, these authors suppose that there were prolonged interglacial epochs, when the ice sheets were in large part or wholly melted away. To the most important of the warm intervals, separating the Kansan and Iowan stages of ice accumulation and advance, the name Aftonian is given by Chamberlin, from Afton in Iowa, where a thick bed of peat, formed during that time, lies between deposits of glacial drift.

Instead of this view of distinct epochs of glaciation, the Ice age seems to me, while accepting the successive stages here noted, to have been still essentially a single and continuous glacial period, with moderate fluctuations of the ice borders during both the growth and wane of the ice sheet. The marginal moraines I

STAGES OF THE ICE AGE IN THE UNITED STATES AND CANADA. Unglaciated land areas are dotted.

consider to have been formed rapidly while the ice was retreating from its Iowan stage, with no important general readvance dividing the Iowan from the Wisconsin or moraine-forming stage.

Not only are the Kansan and Iowan stages of culmination of the ice sheets closely alike for North America and Europe, but also the land depression of the Champlain epoch in both these widely separated great areas brought marine submergence of coastal tracts, and caused rapid disappearance of the ice sheets, with the formation of their drumlins and marginal moraines. These two continents were included in the portion of the earth's crust which twice experienced far-extended epeirogenic movements, first of high uplift, bringing the cold climate and snow and ice accumulation of the Glacial period, and afterward of depression somewhat lower than now, whereby the vast ice fields were melted away.

The accompanying maps * show the area of the North American and European ice sheets in their maximum extension, and at definite times in their recession, as known by their areas of drift and belts of marginal moraines, and by the beaches of glacial lakes formed between the present watersheds and the northwardly retreating ice border. These maps give the boundaries of the Kansan, Iowan, and Wisconsin formations, adopting these names, according to the law of priority, for both continents, and add for the northeastern United States and Canada the subsequent Warren, Toronto, Iroquois, and St. Lawrence stages in the glacial retreat.

The culmination of the great epeirogenic uplift, which had been in progress through the preceding Lafayette period, raised the glaciated areas, both in North America and Europe, to so high altitudes that they received snow throughout the year, and became deeply ice-enveloped. Submerged valleys and fiords show that this elevation was one thousand to four thousand feet above the present height. The accumulation of the ice sheets, due to snowfall upon their entire areas, was attended by fluctuations of their gradually extending boundaries, giving the Scanian and Norfolkian stages in Europe, and an early glacial recession and readvance in the region of the Moose and Albany Rivers, southwest of James Bay.

During the Kansan stage the ice sheet attained its farthest extent in the Missouri and Mississippi River basins and in northern New Jersey, this being probably at the same time with the Saxonian stage, as later named by Geikie, of maximum glaciation in Europe.

In the Aftonian stage the ice sheet receded from its Kansan

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* From Greenland Icefields, chapter xiv, but on an enlarged scale.

STAGES OF THE ICE AGE IN EUROPE. Unglaciated land areas and sea borders of the ice sheet are dotted.

boundary northward about five hundred miles to Barnesville, Minn., in the Red River Valley, and two hundred and fifty miles or more in Illinois, according to Leverett; but probably little between the Scioto River, in Ohio, and the Atlantic coast, the maximum retreat of that portion being twenty-five miles or more in New Jersey. A cool temperate climate and coniferous forests extended up to the retreating ice border in the upper Mississippi region. This great glacial recession was attended with much erosion of the early drift. A corresponding interruption of the severity of the Ice age in Europe is named by Geikie the Helvetian stage or epoch. The greater part of the drift area in Russia was then permanently relinquished by the much diminished ice sheet, which also retreated considerably on all its sides. During this stage the two continents probably retained mainly a large part of their preglacial altitude. The decrease of the ice sheet may have been caused by the astronomic cycle which brought our winters of the northern hemisphere in perihelion between twenty-five thousand and fifteen thousand years ago.

In the Iowan stage renewed ice accumulation covered the Aftonian forest beds, so that the continental glacier extended again into Iowa, to a distance of three hundred and fifty miles or more from its most northern indentation by the Aftonian retreat, and in Illinois it readvanced about one hundred and fifty miles, while its boundary eastward from Ohio probably remained with little change. At the same time, apparently, was the Polandian stage of renewed growth of the European ice sheet, probably advancing its boundaries in some portions hundreds of miles from the Helvetian retreat.

These foregoing stages belong to the early and longer part of the Glacial period, which may be called pre-eminently the Glacial epoch, including the times of mainly very cold and snowy climate which tended to the formation and preservation of the ice sheet. The Iowan stage was terminated by a depression of the ice-burdened area mostly somewhat below its present height, as shown by fossiliferous marine beds overlying the glacial drift up to three hundred feet above the sea in Maine, five hundred and sixty feet at Montreal, three hundred to four hundred feet from south to north in the basin of Lake Champlain, three hundred to five hundred feet southwest of Hudson and James Bays, and similar or less altitudes on the coasts of British Columbia, the British Isles, Germany, Scandinavia, and Spitzbergen. Glacial recession from the Iowan boundaries was rapid under the temperate (and in summers warm or hot) climate belonging to the more southern parts of the drift-bearing areas when reduced from their great preglacial elevation to their present height or lower. The finer portion of the englacial drift, swept down from the

ice fields by the abundant waters of their melting and of rains, was spread on the lower lands and along valleys in front of the departing ice as the loess of the Missouri, the Mississippi, and the Rhine. Marine beds reaching a maximum height of about three hundred and seventy-five feet at Neudeck, in western Prussia, give the name of this Neudeckian stage.

A moderate re-elevation of the land, to approximately its present height, advanced in the northern United States and Canada as a permanent wave from south to north and northeast, keeping nearly equal pace with the continued retreat of the ice along most of its extent. Throughout all the distance from the Atlantic to the Rocky Mountains the mainly retreating but often fluctuating ice margin formed many belts of knolly and hilly drift, called marginal moraines. It is also to be noted that the river basins which slope northward or northeastward were obstructed by the waning ice sheet, so that they were temporarily filled by great glacial lakes, as Lake Agassiz, in the basin of the Red River of the North and of Lake Winnipeg, and a very remarkable series of lakes in the basin of the St. Lawrence, the glacial precursors of the present five great lakes from Superior to Ontario. The very grand development of the marginal moraines in Wisconsin (scarcely, however, surpassing Minnesota) led to the application of the name Wisconsin to this stage of the Ice age and to its drift. In Europe this is named by Geikie the Mecklenburgian stage. Conspicuous moraine accumulations were formed in Sweden, Denmark, Germany, and Finland, on the southern and eastern margins of the great Baltic glacier.

During the maximum extent of the glacial Lake Warren, held on its northeast side by the retreating ice border, one expanse of water, as mapped by Spencer, Lawson, Taylor, Gilbert, and others, appears to have reached from Lake Superior over Lakes Michigan, Huron, and Erie, to the southwestern part of Lake Ontario. Its latest southern beach, traced east by Gilbert to Crittenden, New York, is correlated by Leverett with the Lockport moraine. This and later American stages, all of minor importance and duration in comparison with the preceding, can not probably be shown to be equivalent with Geikie's European divisions belonging to the same time.

In the next ensuing Toronto stage, slight glacial oscillations, with temperate climate nearly as now at Toronto and Scarborough, Ontario, are indicated by interbedded deposits of till and fossiliferous stratified gravel, sand, and clay. Although the waning ice sheet still occupied a vast area on the northeast, and twice readvanced with deposition of much till during the formation of the Scarborough fossiliferous drift series, the climate then, determined by the Champlain low altitude of the land, by the proximity of

the large glacial Lake Algonquin, succeeding the larger Lake Warren, and by the eastward and northeastward surface atmospheric currents and courses of all storms, was not less mild than now. The trees whose wood is found in the interglacial Toronto beds now have their most northern limits in the same region.

Somewhat later came the full expansion of the glacial Lake Iroquois, in the basin of the present Lake Ontario and northward, outflowing at Rome, N. Y., to the Mohawk and Hudson rivers. Gradual re-elevation of the Rome outlet from the Champlain subsidence had lifted the surface of Lake Iroquois in its western part from near the level of the present lake at Toronto to a height there of about two hundred feet, finally holding this height during many years, with the formation of the well-developed Iroquois beach.

The final stage in the departure of the ice sheet which we are able to determine from the history of the Laurentian lakes and St. Lawrence Valley, was when the glacial lake St. Lawrence, outflowing through the Champlain basin to the Hudson, stretched from a strait originally one hundred and fifty feet deep over the Thousand Islands, at the mouth of Lake Ontario, and from the vicinity of Pembroke, on the Ottawa River, easterly to Quebec or beyond. As soon as the ice barrier was melted through, the sea entered these depressed St. Lawrence, Champlain, and Ottawa valleys; and subsequent epeirogenic uplifting has raised them to their present slight altitude above the sea level.

Further stages of the glacier recession are doubtless recognizable by moraines and other evidences, the North American ice sheet becoming at last, as it probably also had been in its beginnings, divided into three parts—one upon Labrador, another northwest of Hudson Bay, as shown by Tyrrell's observations, and a third upon the northern part of British Columbia. From my studies of the glacial lake Agassiz, whose duration was probably only about one thousand years, the whole Champlain epoch of land depression, the departure of the ice sheet because of the warm climate so restored, and most of the re-elevation of the unburdened lands, appear to have required only a few (perhaps four or five) thousand years, ending about five thousand years ago. These late divisions of the Glacial period were far shorter than its Kansan, Aftonian, and Iowan stages; and the ratio of the Glacial and Champlain epochs may have been approximately as ten to one. The term Champlain conveniently designates the short, final part of the Ice age, when the land depression caused rapid though wavering retreat of the ice border, with more vigorous glacial currents on account of the marginal melting and increased steepness of the ice front, favoring the accumulation of many retreatal moraines of knolly and bowldery drift.

COUNTY PARKS.*

By Prof. THOMAS H. MACBRIDE,
of the State University of Iowa.

THE title of this article would seen to require little definition. By county parks are meant simply open grounds available for public use in rural districts as are city parks in towns. There is nothing new in the idea; it is simply an effort to call back into public favor the once familiar public "common." This does not, however, refer simply to public land, such as Government land, to be claimed and plundered by the first comer, nor indeed to land to be used by the public indiscriminately at all, but to land devoted to public enjoyment, purely to the public happiness, a holiday ground for country and city folk alike.

The general features which should characterize such public playground as is here discussed will also quickly suggest themselves to any one who chooses at all to consider the matter. In the first place, the county park should be wooded, that it may afford suitable shade and shelter for those who frequent it; it should be well watered, to meet other patent needs; it should be romantic, in order by its attractiveness to be as far as possible efficient. Above all, it must be under wise control, be at all times suitably warded and kept, that its utility be transmitted from generation to generation. All this is plain enough and will be disputed by nobody. It is the intention here to show that such parks are needed, that they are needed now; that they should have the highest scientific value; and that in the eastern United States, at least, they are everywhere practicable.

The necessity for such parks seems to me to be threefold:

1. As directly affecting public health and happiness.

2. For proper education.

3. To preserve to other times and men something of primeval Nature.

Let us consider these points briefly in the order named.

All of us in one way or another know something of the monotonous grind which makes up the lifelong experience of by far the larger number of our fellow-men—on the farm, in the shop, in the mine, day after day, one unceasing round of toil, into which the idea of pleasure or freshness never enters. How many thousands of our fellow-men, tens of thousands of our women, see nothing but the revolving steps of labor's treadmill, day in, day out, winter and summer, year after year, for the whole span of mortal life! This is especially so in the Western States, where the

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* Read in part as a paper before the Iowa Academy of Science, January 2, 1896.

highest ideal is industry; the highest accomplishment, speed. Our rural population is wearing itself out in an effort to outwear "labor-saving machinery." If you do not believe it, take a journey across the country anywhere through Iowa or Illinois and see how the people are actually living. They know no law but labor, their only recreation is their toil. Now it is needless to say how abnormal all this is. We are as a people entrapped in our machines and are by them ground to powder. The effect of it is apparent already in the public health and will be the most startling factor in the tables studied by the man of science in the generations following. Not to paint too darkly the picture, attention may be called to the fact that rural suicides are not uncommon, and that the wives of farmers are a conspicuous element in the population of some of our public institutions. There must be something done to remedy all this, to preserve for our people their physical and mental health; and to this end, as all experience shows, there is nothing so good as direct contact with Nature, the contemplation of her processes, the enjoyment of her peaceful splendor. If in every county, or even in every township, there were public grounds to which our people might resort in numbers during all the summer season a great step would be taken, as it seems to me, for the perpetuation, not to say restoration, of the public health. We are proud to call ourselves the children of "hardy pioneers," but much of the hardiness of those pioneers was due to the fact that they spent much of their time, women, children, and all, out of doors. All the land was a vast park in which that first generation roamed and reveled. They breathed the air of the forest, they drank the water of springs, they ate the fruit of the hillsides, plum thickets were their orchards, and all accounts go to show that hardier, healthier, or happier people never lived. Such conditions can never come again, but we may yet by public grounds for common enjoyment realize somewhat of the old advantage.

Again, such parks as are here discussed are an educational necessity. Our people as a whole suffer almost as much on the æsthetic side of life as on that which is more strictly sanitary. How few of our landowners, for instance, have any idea of groves or lawns as desirable features of their holdings! If in any community a farm occurs on which a few acres are given over to beauty, the fact is a matter of comment for miles in either direction. A county park well kept and cared for would be a perpetual object lesson to the whole community; would show how the rocky knoll or deep ravine on one's own eighty-acre farm might be made attractive, until presently, instead of the angular maple groves with which our æsthetic sense now vainly seeks appeasement, we should have a country rich in groves conform-

able to Nature's rules of landscape gardening if not to Nature's planting.

I am aware that at first the right appreciation of a public park might be meager. The first instinct might be to use the park as a convenient source whence to draw one's winter fire-wood, or as a free cow-pasture for the adjoining farmer, but such abuse would soon be rectified when the better idea of public ownership came to be understood. This leads also to the remark that such parks in the United States are to-day absolutely needed to teach our people the first lessons in forestry; to advise them how and when to cut timber; the economic value of different kinds of trees and the value of woodland as such; the kind of soil which should be left to trees, and such as may be profitably given over to tillage. We are soon as a people to be sent all to school in matters of forestry and arboriculture; sent to learn the value of the forest in the dear school of experience where we are to be taught the arithmetic of cost.

In the third place, county parks would tend to preserve to those who come after us something of the primitive beauty of this part of the world as such beauty stood revealed in its original flora. I esteem this from the standpoint of science, and indeed from the standpoint of intellectual progress, a matter of extreme importance. Who can estimate the intellectual stimulus the world receives by the effort made to appreciate and understand the varied wealth of Nature's living forms? In this direction who can estimate how great has been our own advantage as occupants of this New World! But such is the aggressive energy of our people, such their ambition to use profitably every foot of virgin soil, that, unless somewhere public reserves be constituted, our so-called civilization will soon have obliterated forever our natural wealth and left us to the investigation of introduced species only, and these but few in number. It is a fact lamented, grievously lamented by all intelligent men, that in all the older portions of the country, species of plants once common, to say nothing of animals, are now extinct. County parks, if organized soon, would enable us to preserve many of these in the localities where originally found.

The objection to all this is that such parks as here broached are impracticable. Such objection can lie in two directions only: (1) the lack of suitable sites, and (2) the lack of suitable control. As to the first, it may be said that in a great number of our counties, especially eastward, such sites exist and have in many cases been long used, and it must be confessed abused, by our people.

Everywhere, even in the prairie States, there are "caves" and "dens" and "fords" and "backbones" and "springs" long popularly named and to some extent enjoyed, places of picnic, ex-

cursion resorts, all of which are in evidence to show at once popular need and popular appreciation. Hundreds of people frequent some of these places every year as they are; what would be the case were it understood that such parklike regions were indeed dedicated to the people for their use and kept and cared for for their enjoyment? Such localities are now generally private property and the public enter by sufferance only. In some places—alas for human nature!—the beauty of the "den" or "palisade" is by its owner ruthlessly defaced as the simplest method of checking an undesirable invasion by the populace. The populace can and should own its own means of entertainment; here and there private benevolence may meet the need, be tolerant of trespass, but it must not be expected.

The second count in the way of objection is a real difficulty whose gravity I do not for a moment attempt to minimize. How to secure, own, and care for several hundred or, for that matter, several thousand acres of land, to be used by all the people, is a problem, especially under our form of government. Were we in the Old World we should find no difficulty. Such localities are owned by the king or his equivalent, and are cared for and guarded with the same assiduity as any other private property. Nevertheless, the people of Europe have free use of the most splendid parks and beautiful woods in the world. The same thing can be true of the United States, hopeless as the task may now seem. In the Eastern States a movement to this end is even now discernible. What Mr. Vanderbilt is doing in North Carolina at Biltmore will doubtless be done presently in all our mountainous and forested States. This is another opportunity for our millionaires, and forest foundations properly established will prove for future generations rich in benediction as any university endowment left in the name of whatsoever State or sect. In Massachusetts five years since a movement was inaugurated for the accomplishment of similar purposes in New England. A board of trustees, by Legislature authorized to act, becomes the legatee of suitable property donated for public use, becomes the curators of such grounds, and the custodians of funds bequeathed for the care of such lands or for their purchase. The result in Massachusetts of such a simple effort has in five years proved most gratifying to the projectors as to every lover of his native land. Thousands of acres have already been rescued from spoliation and subjected to intelligent management such as will eventually result in the attainment of all the beneficent ends for which public parks exist. In most States nothing is done; nothing will be done until somebody or some association of our citizens make a beginning. That the effort will one day be made there is no doubt. Whether it shall be made in time to save that which Nature in this direction

has already committed to our hands is a question. Is not the problem worthy the consideration of all citizens and legislators, and does it not open to us a field where by practical activity we may again show before the world our practical sense and wisdom?

SOCIOLOGY IN ETHICAL EDUCATION.

By BYRON C. MATHEWS.

THE fact that there is great social discontent throughout the entire western world requires no demonstration. The forms in which it manifests itself are numerous. In the various phases of socialism, and in nihilism, it permeates every department of European life. In the rural portions of our country the same spirit of discontent, though in a much milder form, manifests itself in the Farmers' Alliance and in the Populist movement. In our cities and towns it appears in labor organizations and in socialistic societies.

The adjustment of the parts of our social organism is certainly not harmonious. Collisions between classes whose interests are opposed have at times paralyzed domestic commerce, have involved the comforts of the nation, and have reminded thoughtful men and women of conditions preceding revolution. Not infrequently State militia, and even the United States troops, have been called out to protect life and property and to quell riots.

It is important that educators should inquire whether the schools are in any degree responsible for this unfortunate condition of affairs. We are compelled to acknowledge that we think they are, though not in a blameworthy sense, for the forces of no other agency have been guided with purer motives; hence there is no place for condemnation. The relation of the schools to society, however, is so intimate, and their influences are so potent in their formative effects, that it would be folly to claim that they are entirely free from responsibility in this grave matter; since, even if they have not contributed directly and purposely to it, they have not studied to prevent it. They have cultivated, unintentionally of course, those characteristics of the race which have produced it, and have failed to cultivate, except incidentally, those better characteristics which must correct it.

Throughout the whole course of the development of our public schools, their relation to the child as an individual, with personal ends in life to be attained, has always been a prominent feature and a determining factor; while their relation to the child as a member of society has never been sufficiently emphasized. The

effort, therefore, on the part of the schools has uniformly been to enable the child, when grown to manhood, to successfully guard his own interests and secure his personal ends. There has been no general or continued effort to so train and so develop him that he will contribute to the welfare of society. The result has been to center and to fasten his attention upon his personal interests, and to cultivate in him selfishness instead of an altruistic spirit, which is the truly social spirit, and which alone will produce harmony among the classes now in collision. Why has the child been taught to read, to write, to cipher? Primarily because a knowledge of these has seemed to be absolutely essential in securing his so-called rights among his fellows. Only recently has his relation to society been seriously considered. His ethical side is now demanding cultivation more loudly than ever. So far as education is purely intellectual, it only trains him for a fiercer part in the great human struggle for personal ends, and tends to diminish the severity of that struggle in such degree only as purely intellectual culture indirectly contributes to the ethical, through attention to subjects related to the ethical.

Back of all social discontent, back of all forms in which it appears, we find the primary cause of social disorders in the presence of erroneous ideas among men, particularly the presence of erroneous notions concerning the relations which exist among men. There are certain fundamental ideas upon which the social edifice is built—pivotal ideas about which the social world turns. In each of these ten thousand others germinate; and the ten thousand are wrong if the one is wrong. The following are examples of these erroneous, fundamental, pivotal ideas, which have become stock notions of the people: Cæsars and Napoleons are civilizers; royalty is related to the gods; the Creator made some to be served, others to serve; legality is justice; standard belief is more important than standard character; morality divorced from religion is dangerous. Any social structure founded upon such ideas alone is a monstrosity. To-day we stand face to face with the fact that these very ideas, and others like unto them, form a very large part—entirely too large a part—of the foundation of modern society.

All existing governments and all other institutions have been at some time simply abstract ideas in somebody's brain, and afterward have become concrete realities; right ideas giving birth to right institutions, wrong ones to wrong institutions. This same relation of cause and effect which exists between ideas and institutions, exists also between ideas and the character of individuals, and between ideas and the character of the relations which exist among individuals. Just so far as individual character and existing relations among men are right, they are the product of

right ideas; so far as they are wrong, they are the product of wrong ideas.

If, as we think, the presence among men of erroneous ideas is the cause of social disorders, the cure will be their displacement, through educational processes, with such as will produce right character in men and inspire right relations among men. We believe this is entirely possible, and we think that both the agencies and the methods are in sight. Both must be educational. All political and legislative schemes, the single-tax theory, the nationalization of land and industries, all socialistic projects, all coöperative remedies, will prove of little avail, if they aim at curing social disorders by improving the environment only of the man. *The man himself is wrong.* He is the thing which needs correction and improvement; not the world in which he lives, or the form of government under which he lives. The only possible way of correcting him, and through him of permanently curing social disorders, is through the processes of education—education of the child with the potential man in him.

The Church, the press, and the schools are the agencies which, supplemented by other forces, have determined the existing fundamental ideas of society. If these agencies have been able to formulate and fix these, they certainly can modify them, or even displace them by others. The functions of these agencies, however, and the methods employed in the execution of these functions, must be modified, some even revolutionized. Although the Church and the press, the discussion of whose functions and methods the limits of our paper forbid, are powerful agencies whose influence is beyond all computation, or even conjecture—which must be employed in the improvement of social conditions—yet they are not the agency upon which greatest reliance can be placed. This is found in the schools—the great free public-school system. There is greatest hope in this agency for many reasons: particularly because its organization, and no other, is fully adapted to the requirements of the situation; because it deals with the child, which is a moldable and not a crystallized thing; and because the schools are the agency which in large degree determines the character of all other agencies.

Our hope, then, is in the schools; but their function and their methods must be modified, because they are not giving to the world the best they can give. They are not giving what the world most needs—the best possible character, which results very largely from a careful, rational study of our relations to others, from a right understanding of all those relations which are interwoven everywhere among men in all phases and departments of life. Nothing is more important for our children and youth to understand than the nature and character of human relations;

but these are ignored, as if there were no such relations. Here, in our judgment, is the most serious defect of our schools, and not in the lack of proper "correlation" of studies.

Whether the study of human relations is the province of the schools we can not stop to discuss, but pass it with the remark that the schools belong to the people, and the people have the right to do what they please with their own. They can make the function of the schools whatsoever they choose to make it—whatsoever will serve themselves best.

How can this most serious defect be remedied? By introducing instruction in pure human ethics, divorced from religion, which then becomes a study of the relations which exist among men in this real world. One great difficulty in the way of providing instruction in ethics heretofore has been the lack of a clear distinction in the minds of the people between ethics and religion. The Christian world has been in the habit of thinking and of claiming that there can be no valid system of ethics, except that which is based upon the existence of God, and upon the relations which we suppose exist between him and us. This claim has never been substantiated in a manner satisfactory to scientific thought. Religion is a system of beliefs and worship, and points to an after life, for which we all hope; while ethics is a system of principles of conduct for man as a social being in this life, which we are all now living. Ethics deals with realities, with a real life in a real world. Its realm is entirely a realm of actualities; while the realm of religion, defined in a scientific manner, is one of beliefs and hopes. So far as these beliefs and hopes are determining factors in the conduct of man to man, the realm of religion affects the realm of ethics. But apart from this, if by some magic power the realm of beliefs and hopes were annihilated, the realm of ethics would remain absolutely undisturbed. Does ethics, then, find its basis in religion? Does that which is real depend for its existence upon that which we suppose to be real? It may, providing that which we suppose to be real is actually real; but when, as in this case, it is beyond human powers to determine whether it is real or not, it is about as unphilosophical to declare that something which is known to be real depends for its existence upon another something which we suppose to be real, as to declare that the Himalayas hang upon the sky. The only possibility of substantiating the claim that ethics and religion can not be divorced is found in so formulating a definition of one of them as to embrace in it the realm of the other. But such an attempt would be futile in this scientific age of discrimination and definition. Ethics and religion are both right, and have their separate and appropriate missions and fields, which, as we have indicated above, overlap; but their foundations are two distinct things in

reality, and ought to be made so in definition. The sooner this distinction is recognized, the more rapid will be the moral development of the race.

Upon what, then, can a system of ethics be based? *Upon the fact of human relations.* If there were only one human being in the world, there would be no need of an ethical system, because there would be no other man with whom he could have any relations. Neither would there be any need of it if the inhabitants were few, and were so scattered over the earth that no one of them, in securing for himself the necessaries of life, would ever come in contact with any of all the others. But, just so soon as any one place on the earth becomes the common abode of two, so soon relations are established between them, and there is need of principles of conduct governing each in his acts which in any way affect the other. An ethical system to control the actions of these two men alone would be very simple. But when, from increase of population, or for motives of common interest, individuals unite and form a tribe, there comes to be tribal ethics. When two tribes come in contact, intertribal relations are formed; and when tribes grow into nations, national and international ethics arise; and as the life of the individual becomes more complex within itself, and more involved in its relations to other members of the same tribe or nation, and as the nations increase in size and number, the rules governing this increased complexity must by necessity become more and still more complex, until we have the most possible complex system of ethics governing the most highly developed society. It is here, in this fact of human relations, that we find a basis for human ethics. It is the instruction of our children and youth in these relations for which we plead as a remedy for social disorders. Some recent modifications of school work point toward such instruction; but, in our judgment, none of them are calculated to satisfy the demand of our day. The moral results of the work in the kindergarten, where the little ones are unconsciously instructed in their relations to each other, can not be overestimated. Similar results ought to be produced all along the line of educational work, but these can not be secured through kindergarten methods with children beyond kindergarten age. Other methods must be invented appropriate for different ages.

If the study of human relations is so important, how can our children and youth be instructed in them? We venture to reply that this end can be attained by the introduction, in elementary and as yet undeveloped forms, of the new science of sociology, which, if not scientifically defined as the science of human relations, certainly treats of the whole realm of these relations, and no other science does. There is evidence that "the education of

the future will be sociological; that the supremacy which has been accorded to the physical sciences will be transferred to sociological studies."* The tendency is certainly in this direction. It is seen in the methods employed and in the character of the work done in the kindergarten, in the comparatively fruitless efforts to extract moral lessons from subjects already taught, in the use now being made of the story and myth in literature, in the making of text-books with a view to moral impression, in the provision made for manual training, and in the preference shown by the Committee of Fifteen for "an objective and practical basis of selection of topics for the course of study, rather than the subjective basis so long favored by educational writers." † All this is in response to a demand that our schools must do something more than to cultivate brain power. They must also guide it. All possible means must be utilized in meeting this demand; but, in our judgment, it can be more fully met through sociological studies than through all the means and methods now employed. This line of study can, without doubt, be made the vehicle for effective moral impression.

Apart from the ethical character of this new science, which renders it superior to all other subjects for ethical purposes, it possesses two very important advantages which disarm two classes of objectors to ethical instruction. One class is composed of those who say that we can not teach ethics, because that means religious instruction. This objection falls to the ground through the separation of ethics and religion, which this new science assists in establishing. Since this is so, and since the ethical codes of all parties interested in the schools are substantially the same, and since there is no hope that the state will ever provide for religious instruction, may we not hope that on this ethical ground which sociological studies furnish, a compromise may be effected through which something may be accomplished in the schools of vastly greater importance to humanity than any degree of manual training, or even of purely intellectual development? Those who are opposed to religious instruction would not be losing their case, since ethics is not religion. All who desire religious instruction would, from their point of view, be gaining their object in part, since they include ethics in religion. To no party would this be a sacrifice of principle.

The second class of objectors declare that direct moral instruction would be abortive; that all moral impression must be made indirectly. This is an assumption to which the facts of experience are opposed. However, without stopping to argue

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* Prof. Fulcomer, Lecturer in Chicago University.

† Report of Committee of Fifteen.

this point, we present to this class of objectors this same subject, which can be so handled, if it is desired, as to slyly insinuate moral lessons into the boys and girls when they are off guard—side-flank them. With this notion we have no sympathy. Moral training must be known as moral training. An importance of its own must be attached to it by placing it on the same level with, or even above, every other branch. On the other hand, sociological studies can be so employed as to openly, frankly, teach matters of right and wrong, and stamp such an importance upon the right as to make a profound impression.

The ways and means of teaching this new science must be discovered by trial. Whatever is said here in reference to this point is purely suggestive and tentative. The present undeveloped condition of the science requires that first effort shall be made with the most mature pupils, hence in the high schools. Later, without doubt, what may be called elementary sociology will be developed and adapted to the other grades. Child sociology is already taught in a practical way in the kindergartens.

The primary aim ought not to be to acquaint high-school pupils with the theory of sociology, desirable as that may be, but to make them as familiar as possible with the multifarious relations of life, before they enter upon them as individuals independent of parental protection and guidance. Perhaps I can indicate most clearly the line of work, as it lies in my own mind at present, by venturing a few thoughts upon the character of a text-book suitable for this work. I would devote the introductory chapters to the establishment upon a philosophic basis of some universally accepted ethical principles, with which human actions are to be compared and adjudged as right or wrong. The best, the simplest, the most easily understood, and the most generally accepted is, "Do unto others as you would have them do unto you." In our judgment this is entirely sufficient. Nothing better is known, and I would make a text-book sing the spirit of this beautiful principle of social life on every page. It is the condensed epitome of all the ethical teachings of the great Master of ethics as they are recorded in the New Testament; hence, acceptable to all Christian peoples and institutions. This can be based upon a philosophic induction from social data. This, perhaps, would clothe it with an authority which, because it has been heard so often and so universally ignored, it unfortunately does not now possess.

A similar induction might be made to result in some other general principle, if that is desired, like that of Bentham, which, without philosophic verbiage, is that that is right for this world which aims at the greatest degree of happiness to the largest number of persons. These and other like generally accepted

principles are sufficient guides for all in all ordinary situations in life. After these have been established they must be so stamped upon, so burned into the mental fiber of every pupil, that he must by necessity carry them through life; that he can not by any possible line of conduct cause them to fade out, or by logical process silence their voice. This result I would make the aim of the remainder of the book, which should embrace civics in all its branches, business and industrial relations in all their ramifications, natural rights and duties of the individual, the objects, rights, and obligations of society and governments, and all kindred subjects.

Civics embraces duties to country and whatever contributes to best citizenship. Under this topic I would direct attention to political abuses of all sorts, and impress the importance of living by the same moral code in politics as in religion. I would discuss whatsoever would bring plainly to view the individual's ethical duties and obligations to country and government. In the treatment of business relations I would go into the details of the various branches. It seems entirely practicable for a man familiar with business life and methods to conduct students equipped with their code of universally accepted moral principles, according to which human actions are to be classified as right or wrong, into and through the ten thousand ramifications of all kinds of business, behind the counter, into the bank, into the boards of trade, into the business and professional office, into the exchanges, into the council chambers of great corporations, into every corner of the business world, and study the relations which exist among all who are occupied there, as well as between these branches and the great world outside. Here the like relations of the industrial world should be considered, the relations between those who possess capital and those who labor, between those who employ and those who are employed, the rights of each and the duties of each to the other.

In treating of the natural rights and duties of the individual I would attempt to impress the ethical relations between individuals which arise from the fact of birth. All are in the world through no merit or fault of their own, hence no credit or blame attaches to the fact of being here in any case. No man brought anything with him which every other man did not bring; hence all by Nature are endowed with equal rights and entitled to equal opportunities. This opens up an immense field of thought in the direction of modifying the existing conditions of unequal rights and unequal opportunities, which all students of social questions recognize with serious misgivings.

Closely allied with this subject are the objects of social organization, the relations which exist between society and the indi-

vidual, the rights of each, and the duties of each to the other. Society is a necessity. Being a necessity, it ought to be so organized as to continue and perform its functions with the least possible friction, and the greatest possible comfort and happiness to all who compose it. Hence the immeasurable importance of investigating, and of establishing in the minds of the rising generations an ethical adjustment of the parts of the social organism.

MASSAGE IN SPRAINS, BRUISES, AND DISLOCATIONS.

By DOUGLAS GRAHAM, M. D.

IN the Life and Letters of Mr. George P. Marsh, Volume I, page 219, is the following account of the brilliant success of the treatment of two sprains by a wild Arab: "There seemed, however, small chance that the proposed journey to Sinai, Petra, Jerusalem, etc., could be carried out. The season was already far advanced for desert travel; Mr. Marsh had seriously sprained his ankle at Karnac while carrying his wife through the great temple, and could not now walk without the assistance of two persons; and Miss Paine had been suffering from a somewhat similar sprain even before leaving Constantinople, and had profited little by the surgical skill of the Franks at that place or in Egypt. The dragoman, though it was clearly for his interest that the journey should be made, admitted the impossibility of it under these circumstances, and gravely proposed that the two sprains should be cured at once by an Arab doctor of his own acquaintance. He entreated so earnestly and with such apparent confidence in his miracle-worker that a consultation was held with some of the oldest and most intelligent of the Frankish residents at Cairo, and, though no one would exactly take the responsibility of advising it, every one said that the evidence of these immediate cures was such that he should certainly try the experiment in his own case. Some, indeed, had tried it with entire success, and no one thought any harm could come of it.

"These considerations, added to an intense desire to see more of the mysterious East, decided the lame patients to call in the '*radoubeur.*' So, the second morning after their installment in their hotel, Achmet presented himself, bringing with him the most extraordinary creature that can be well imagined. He was scarce five feet in height, and was clad in a single garment of blue cotton fastened about the waist with a leather belt. His old, withered face was lighted up by one eye only, and that seemed but half open, while nothing about his person would have led one to believe that the waters of the broad Nile were within reach. There

was an unmistakable look of mortification on the part of those who had consented to summon this Æsculapius, but there was no help for it now. At this moment a visitor was announced to Mr. Marsh, and the lady therefore was the first to prove the wild man's skill. He examined the injured foot, placed it in warm water, dipped his own fingers in olive oil, and rubbed and pressed the foot very gently for about twenty minutes. He then carefully dried it and bade his patient walk. She hesitated, having suffered so much and so long from every effort of that kind; but an imperative '*Imsheh, imsheh,*' decided her. She placed her foot firmly on the floor and took a step, another and another, and still no pain. In a few minutes she was in the street, and, after strolling some hours among the bazaars of the city, returned without the least feeling of discomfort. The cure was perfect and permanent.

"In the meantime Mr. Marsh had passed through a more severe ordeal at the hands of the magician. His foot and ankle, which were both badly swollen and discolored, were very sensitive to the manipulation, and especially to the energetic pulling which in this case was a part of the treatment, and at the end of three quarters of an hour he was well-nigh exhausted by the pain. But then, on looking at his foot, he was surprised to find that the swelling had disappeared, the color was almost entirely natural, and the shoe and stocking, which had been laid aside for almost two weeks, were put on with perfect ease. He was then directed to walk, which to his amazement he found he could do without the least pain; and the only unpleasant sensation he experienced afterward was a slight stiffness for the first day or two, which, however, did not in the least interfere with walking. After this, preparations for forty days' wandering in the desert were made as rapidly as possible."

Making allowance for the enchantment that distance always lends, there is little doubt that these two injuries were much benefited by the manipulations of the wild Arab. But it is very evident that he hurt his second patient much more than there was any need of. It would, indeed, be strange if the teachings of science did not enable us to improve on the methods of blind instinct. And though science often follows art with limping strides, yet here we can say that science has caught up with art and together they work for the rapid amelioration of disabled joints. No sane person would think of having massage applied immediately to the seat of a sprain, but many imagine that this is what the *masseur* will do, and hence deprive themselves of the early benefit that might be got from this method of treatment, which quickly relieves the pain, the heat, and the swelling, removes the pressure from terminal nerve filaments, and prevents the parts from stick-

ing together. No two *masseurs* are alike by nature nor in skill, tact, and education, and the one who knows his anatomy and physiology well, when called to a recent acute sprain, will not begin at once to *masser* the injured joint, but at a distance above it on the healthy tissues by gentle stroking or *effleurage* toward the heart, gradually proceeding nearer and nearer to the painful place. This has a soothing effect and pushes the flow along in the veins and lymphatics, making more space in them for the returning currents coming from beyond and carrying away the fluids that have leaked out of the vessels. The same should be done on the part of the limb beyond the joint, for the circulation is hindered both in going out and coming in by reason of the swelling.

Next, the *masseur* who knows his business will begin again at a safe distance above the injured joint, and use deep rubbing, kneading, or massage properly so called, one hand contracting as the other relaxes, alternately making circular grasps, with the greatest pressure upward, and this should be done on the parts above and below the seat of sprain. By this procedure the effects of the previous stroking or *effleurage* are much enhanced an analgesic or agreeably benumbing effect is produced upon the nerves which extend to the painful place, and the retarded circulation is pushed along more vigorously, making room in the vessels for the swelling, the effusion, the dammed embargo caused by the landslide of blood and lymph that is inundating the surrounding territory with exudates farther up the stream to float off, and preparing the way for the next step in treatment. At the end of fifteen or twenty minutes of this manner of working, gentle, firm pressure can be made immediately over the swollen and but recently very tender parts, which in a few seconds can have circular motion, with the greatest push upward added to it; and this, if sufficient tact be used, will in all probability not hurt but be positively agreeable. By this the swelling is spread over greater space, pressed out of the tissues as water is out of a sponge, and brought into more points of contact with the veins and lymphatics by which they are absorbed and carried off; the same pressure that causes the dislodgment of stagnating fluids also aiding absorption by pressing them into the small vessels. Then a snug, well-fitting bandage should be applied, which may exhibit the bungling of a tyro or the skill acquired by twenty years' practice. Under this plan of treatment, used twice a day, the comfort produced and the speed of recovery would scarcely be believed unless experienced by one who had had a similar injury treated in the regular orthodox way, with absolute rest and immobility, by means of fixed dressings.

Some years ago I published the results of massage in more than seven hundred cases of sprains, joint contusions, and distor-

tions of all degrees of severity, treated by many different observers, most of whom were French, German, and Scandinavian army surgeons, in order to confirm the experience obtained in some of my own cases. The invariable result of each and all was that such injuries thus treated got well in one third of the time that similar cases did under the usual method of absolute rest and fixation, and with less tendency to subsequent weakness, pain, and stiffness. Experience teaches that the sooner after a sprain massage is begun, the quicker is the recovery. In Germany the military authorities now require a semiannual report from their surgeons upon the results of massage in injuries of joints; and the statistics of Gasener, Starke, Körner, and others clearly show the rapid results of this method, and the economy of time to the soldier. I fear it will be a long time before many of the physicians and surgeons in the United States will condescend to try their hands at massage; indeed, most physicians adopt, prescribe, or tolerate massage in the same way that Constantine the Great embraced Christianity—more from policy than conviction.

The orthodox treatment of absolute immobility alone in these cases has little else to support it than the dogmatism of centuries, from which it is almost impossible for a surgeon to free himself, unless he has been the unfortunate victim of a sprain, and had it treated with massage. Supposing a prize of ten thousand dollars were offered for the quickest way to make a well joint stiff, what more effectual means could be resorted to than first to give it a wrench or sprain, and then do it up in a fixed dressing, so that the resulting inflammation would have an opportunity of producing adhesion of the parts? And this is the prevailing treatment of sprains. The same plan of treatment is employed for the purpose of closing up holes in other parts of the body—namely, that of exciting adhesive inflammation; and, unfortunately, it sometimes closes the cavity of a joint also.

It would seem as if we had sufficient proof of the beneficial effects of massage in injuries and affections of joints in human beings, without intentionally inflicting similar injuries on animals in order to treat them by massage, and study the effects of this upon them. However, much interesting and confirmatory evidence has resulted from such experiments, and the effects produced are no longer left in the realm of theory, but brought into the sunny light of science and ocular demonstration. The mind of man may be prepossessed in favor of massage, and this would help recovery; of animals it can not be, unless they had had massage before for a similar hurt. Animals that have been treated by massage can be killed and the effects studied and compared with similar injuries in other joints of the same animal that have not had massage. Von Mosengeil, Professor of Surgery

at Bonn, injected corresponding joints of rabbits with Indian ink. With each rabbit he *masséed* one of the joints at regular intervals, and left the same joint in the other limb untouched. The swelling and stiffness caused by the injection rapidly disappeared under massage, and on examination of the *masséed* joint after the animal was killed it was found empty of its colored contents. Even when the examination was made shortly after the injection and the use of massage, there was scarcely any ink found in the joint; part of it was found upon the synovial membrane, and upon microscopical examination it was seen that the greatest part of it had been forced into and penetrated through the synovial membrane. The darkened lymphatics could even be seen with the unaided eye extending from the injected joint to the lymphatic glands in the groin or axilla, and these latter were also black from the absorption of the ink. Upon examination of the joint cavities that had not been *masséed*, the ink was found in the joint, mixed with the synovia, forming a smeary mass, and it had not even penetrated the tissue of the synovial membrane. The same results were uniformly obtained in all the experiments, showing that absorption takes place from joint cavities by means of lymph spaces and small openings communicating with lymphatic vessels, and through these with lymphatic glands.

But by far the most interesting experiments yet performed to elucidate the effects of massage on joints, muscles, and nerves are those described at length in the *Archives générales de Médecine* for 1891 and 1892. Having obtained excellent results from massage in bruises of joints and muscles, in sprains and dislocations, and also in fractures, some of which were *masséed* from the commencement of the injury when there was no displacement, and others where there was displacement, after a fixed dressing had been applied as short a time as possible to keep the parts in place, M. Castex sought further opportunities to study more exactly the results of these injuries by intentionally producing them in corresponding places in two limbs of dogs, *masséing* the seat of one of these injuries and letting the other alone, and after five or six months killing the animals and examining the tissues that had been hurt under the microscope. He always chose the more injured limb for treatment and the other had no massage, but was left to the natural evolutions of the injuries. The effects, immediate, consecutive, and remote, were carefully noted by experts in laboratory work, who were not told which leg had been *masséed*. The experiments were done in the laboratory of Prof. Richet. The massage was done either immediately or very soon after the injuries—even in the case of the dislocations, as soon as they were set—and always with marked

relief to the pain, swelling, and stiffness; so much, indeed, that after a few massages of five or ten minutes each of frictions and *pétrissage* once a day, the dog had full use of the leg that had been *masséed*, whereas the leg that had not been *masséed* remained swollen, stiff, and painful for a long time, and in some did not recover at all. It is but fair to state that, no matter how severely some of the dogs were injured, especially the shepherd dogs, they did not seem to mind it at all after it was over, running about as if nothing had happened as soon as they were set at liberty. These were not chosen for massage. The details are amazingly interesting, but space forbids mention of more than one of the experiments, which may be taken as a fair sample.

The two shoulder joints of a large watchdog were dislocated by inward flexion. The head of the humerus of each was plainly visible under the skin, showing a luxation forward and inward—intracoracoid. It was easily reduced, put back in place, by traction. Five minutes of massage was at once given to the right shoulder, which seemed to afford relief, judging from the grateful way in which the animal submitted; and after this a figure-of-8 bandage was applied around both shoulders. He had massage five minutes daily to the right shoulder alone, and for the first three days he walked with difficulty. The right shoulder gradually became less painful to touch, and he stood firmer on this side. On the fourth and subsequent days all sorts of pressure upon the *masséed* shoulder were borne without discomfort; but when the other shoulder was pressed the dog growled and attempted to bite. Six days after the dislocations he supported himself well in the *masséed* limb, but held the other up, as the *non-masséed* shoulder was still swollen and painful. Both shoulders then staid in place, in spite of passive movements that might have dislocated them. On the eighth day the dog walked well with the *masséed* limb, but held the other up, as the latter was still swollen and painful, and there was crepitation in the joint. Thirteen days after the injury the dog took an occasional step with the limb that had not been *masséed*, and two months later it was in about the same condition, while he made free use of the limb that had been *masséed* in walking and running. There was then atrophy (wasting) of the muscles of the left shoulder, evident by the prominence of the bones; none, of the muscles of the right.

Testimony in favor of the early use of massage in dislocations in human beings, being careful not to move nor disturb the joint, is gradually accumulating. Not only M. Castex, but also MM. Fége, Archambaud, and others, have reported more favorable results from its application from the very first day of the injury than when it had not been used. Passive motion, I think, should not be begun until the patients find that they can make a little

voluntary motion. Fifteen or twenty days of this treatment seems to be all that is necessary in mankind; and this is just about the length of time required for the repair of the rent in the capsule. In the meantime, the surrounding tissues are preserved in health and activity by means of the massage.

Soon after the swelling from the injuries to the dogs had subsided the muscles became more or less atrophied in the limb that had not been *masséed,* but not at all in the limb that had been *masséed.* At the end of five or six months the dogs were killed and the tissues examined by the microscope. The muscular tissue of the side that had not been *masséed* presented a diffuse sclerosis or hardening; the connective tissue intervening between the fibers and bundles of fibers was thickened; there were interstitial hæmorrhages, especially in the cellular tissue around the

FIG. 1.—BRUISED MUSCLE WITHOUT MASSAGE. *f*, muscular fasciculus; *c*, intermuscular connective tissue.

FIG. 2.—BRUISED MUSCLE WITH MASSAGE. *f'*, muscular fasciculus; *c'*, intermuscular connective tissue.

Fig. 2 shows that the natural size of the intermuscular connective tissue has been preserved, while Fig. 1 shows the intermuscular tissue thickened, and the muscular bundles thinner and compressed. (From the *Archives générales de Médecine*, Fevrier, 1892, p. 197.)

muscles; the internal and external coverings of the bundles of muscular fibers (perimysia) were infiltrated with blood, and also the fascia or covering outside of this. The transverse markings of the muscular fibers (striæ) were effaced in many places, while the longitudinal striation or marking, which is not seen normally, was very distinct. The muscular tissue from the corresponding region that had been *masséed* was found to be normal in every particular. M. Castex has left us to surmise the appearance of the sarcolemma or covering of the individual fibers. In all probability this also was hardened, thickened, and infiltrated with blood as were the outer and larger coverings.

The blood-vessels appeared perfectly natural from the *masséed* side, but from the side that had not been *masséed* they presented a hyperplasia or thickening of their external coat.

The nerve filaments were found to be natural in the *masséed*

side, while in the side that had not been *masséed* there were abundant evidences of neuritis, and perineuritis exerting destructive compression upon the nerve fibers. The perineurium, or sheath covering the bundles of nerve fibers, was at least three times as thick in the *non-masséed* side, and the connective tissue around the perineurium was also thickened with numerous new-formed cells. The small vessels in the perineurium were also the seat of a peripheral hyperplasia or thickening. The lesion of the nerves was more marked than that of the vessels.

These experiments of M. Castex give more emphasis than ever to the remarks of old Arrian in the year of our Lord 243, that "great is the advantage of rubbing to the dog, not less than to

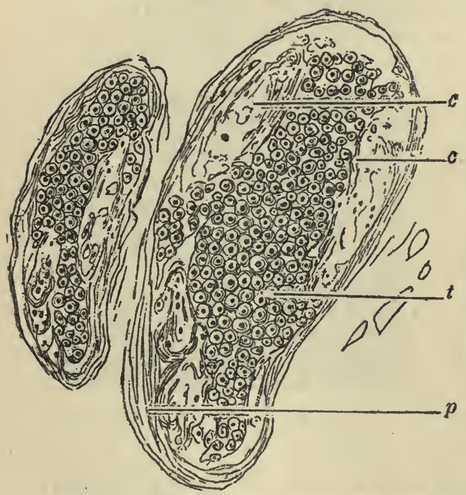

Fig. 3.—Injured Nerve without Massage. *p*, perineurium; *t*, nerve tubes or fibers; *c c*, new-formed connective tissue.

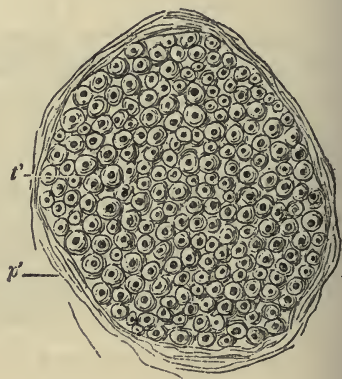

Fig. 4.—Injured Nerve with Massage. *p'*, perineurium; *t'*, nerve tubes or fibers.

In Fig. 4 all the nerve elements are of normal appearance, while the nerve elements from the *non-masséed side*—Fig. 3—show that the perineurium is thickened, and underneath this there are deposits of new-formed connective tissue which crowd and compress the nerve fibers. (From the *Archives générales de Médecine*, Fevrier, 1892, p. 200.)

the horse, for it is good to knit and to strengthen the limbs, and it makes the hair soft and its hue glossy, and it cleanses the skin from its impurities. One should rub the back and the loins with the right hand, placing the left under the belly in order that the dog may not be hurt by being squeezed from above into a crouching position; and the ribs should be rubbed with both hands, and the buttocks as far as the feet, and the shoulder blades as well. And when they seem to have had enough, lift her up by the tail, and, having given her a stretching, let her go. And she will shake herself when let go, and show that she liked the treatment." (*Arrian Cynegeticus.*)

In human beings M. Castex found that when massage was begun early or from the very first in contusions, sprains, and dislocations not only were the immediate symptoms soon relieved, but also the subsequent serious consequences that are so apt to follow these injuries—wasting, weakness, contraction, and stiffness—were prevented. But when he tried massage in old cases of muscular atrophy or wasting following injuries to joints he got no increase of muscular tissue. The stiffness was got rid of; the muscles became suppler, but they still remained thin and lacking in strength. If he had combined passive and active movements with the massage he would probably have gained growth of muscle. He found that the galvanic and faradic currents were of benefit in promoting increase of muscular tissue. Muscular contraction produced by electricity is but another form of motion.

Numerous theories as to the cause of muscular atrophy from injuries to joints have been considered and abandoned. The most probable and most generally accepted is that of reflex action. The injury to the joint starts up more or less inflammation (arthritis); the articular nerves are irritated; this irritation is transferred to the spinal cord; the nerve centers affected act in turn upon the centrifugal nerves going to the muscles, and these determine at their peripheral ends the muscular atrophy. With a view to the elucidation of this, M. Deroche has repeated seven times, and always with the same results, experiments which were done for the first time at the College of France by MM. Raymond and Onanoff. He divided the posterior roots of the three last lumbar nerves on *the left side* in dogs and rabbits. After cicatrization had taken place he assured himself that numbness was complete from the thigh to the knee of the left lower limb, so that irritation of this region was not felt. The corresponding limb was left intact. An arthritis was then excited in both knees by introducing a thermo-cautery into them. *No pain was felt in the left knee,* but much in the right. Three months afterward the animals were killed, and in both knees the lesions of arthritis were found; *but the muscles of the thigh of the left leg were of natural size; of the right, atrophied.*

Prof. Simon Duplay and M. Cazin have also made a careful study of this subject in much the same way. Under the microscope they found that the articular filaments always presented signs of inflammation; but the large nerve trunks and spinal cord showed no appreciable change, and the results of the examination of the muscles were negative except as to diminution in size. They therefore concluded that muscular atrophies consecutive to joint injuries consist of simple atrophy, and that this can only be explained by a dynamic action, a simple reflex

due to irritation of the terminal nerve filaments of the articular nerves.

M. Deroche thought he found that the muscular atrophy was due to diminution of interfibrillary substance, and that there was an ascending degeneration of the posterior columns on the same side. However that may be, the inference is certainly justifiable that massage acts to prevent muscular atrophy by maintaining an influence, a movement, or something in the muscles which the spinal cord is for a time unable to impart to them; and in order to do this, it should be applied immediately or soon after the injury, for then it is more quickly aroused from the lethargy and stupor into which it has been plunged by the shock of the accident.

PEARLS AND MOTHER-OF-PEARL.

By CHARLES STUART PRATT.

AMONG the picturesque industrial possibilities of our southern Pacific coast is the artificial production of pearls. By this is meant, not the manufacture of artificial pearls, but the artificial growing of real pearls; that is, instead of the haphazard pearl-fishing of the present, the establishment, on the southern California coast, of oyster ranches, where the pearl-producing bivalves shall be scientifically directed and assisted in growing both gem pearls and mother-of-pearl.

This is hardly more visionary than was the recent establishment of ostrich ranches just inland from this same Pacific coast. A glance at the natural process of pearl-making will throw some interesting light on these oyster ranches-to-be. Mother-of-pearl is the natural product of the wild oyster, if we may so designate the bivalve of the unfenced sea bottoms. To secure a smooth surface for the contact of its soft, sensitive body, the oyster lines its coarser, rougher shell with a substance named nacre—which is simply carbonate of lime, with a trace of organic matter. This nacre is secreted and deposited in successive layers of filmy thinness and of marvelous smoothness of surface; the result is the lustrous, iridescent motherof-pearl.

Unlike mother-of-pearl, the gem pearl, round or otherwise, is an *un*natural product of the oyster. The gem pearl is an accident, almost a disaster, to its creator. In fact, a healthy, undisturbed oyster never produces a pearl. But if a sharp grain of sand finds its way inside the shell, the disturbed oyster protects its tender, sensitive flesh from the irritation of this offending substance by depositing about it smooth coatings of the nacre with which it has already formed or deposited the mother-of-pearl

lining of its shell. Layer after layer is added, until finally we have the round, lustrous gem for brides' fingers and the throats of queens.

It is possible that in some cases a wound throws off bony particles which become the nucleus of the pearl; or, in place of sand, the foreign substance may be a minute parasite, or a morsel of seaweed, or one of the tiny siliceous vegetables known as diatoms, or even one of the eggs of the oyster itself. Some such encysted particle, though perhaps of microscopic size, lies at the center, and was the cause, of every pearl. So the pleasure-giving gem is really the outgrowth of pain.

Now, it has been discovered that, instead of waiting the accidental intrusion of the alien particle into the shell of the oyster, grains of sand, or other objects, for the nucleus of the pearl, may be deliberately inserted by the hand of man, and that the oyster will at once set to work at pearl-making. It is known that the Chinese, from a remote period, have ingeniously taken advantage of this singular self-defense of the oyster. In the month of May the river mussels are taken from the water, and small pellets of clay, and even tiny images of the gods, are slipped inside the shells. The mussels are then replanted and left half a year. In November they are taken up again, and, while some of the shellfish die, most have coated the clay pellets and little metal gods with nacre, producing real pearls and genuine mother-of-pearl deities.

These mother-of-pearl Buddhas are in great demand with the curious and the devout, but there is no evidence that any of the priceless pearls of the world have been so produced. And yet surely the results obtained suggest great possibilities for the enterprising man who shall establish the oyster ranches already mentioned, and who shall add to the ingenuity of the Chinese all the resources of modern science.

The thin layers of nacre are always deposited thicker in depressions than over elevations; hence uneven surfaces become level, and small particles of whatever form gradually become spherical. The perfect round pearl, however, can only result when the nucleus penetrates the soft body of the oyster, or remains unattached to the shell. Often it does become so attached, and when removed has a defect on one side, and can only be used in settings where that side is hidden; such pearls are called *boutons* or button pearls; odd, irregular shapes are called *baroques*.

Large or heavy intruding objects are quite likely to become attached to the lower half of the shell. Such objects often, in the course of years, are buried from sight under successive layers of nacre. Some Chinese Buddhas thus imbedded in the flat or lower halves of the bivalves are to be seen in London museums, and they

illustrate the curious fact that the oyster has the habit of forcing intruders out, not manlike through the door, but through the walls of its house. The way of it is this: while the successive coverings of nacre are deposited on the inside of the shell, the outside of the shell is gradually decaying and crumbling away, so that as the wall inside the alien object becomes thicker, the part outside becomes thinner, till finally the intruder reaches the surface—is literally forced through the shell of the oyster.

The pearl is the one gem that comes to us perfect from the hand of Nature, and to this its great antiquity as a gem is largely due. Precious stones whose beauty and brilliance depend on polishing and cutting would naturally be discovered and utilized later. The discovery of the diamond, for instance, probably dates within historic times. Though known earlier, it was not generally included among the gem treasures of royalty even as late as the seventh century. The modern cutting of diamonds in regular facets was invented as recently as 1456. Indeed, it is quite probable that the pearl was the first gem known and treasured by prehistoric man—since the search for food must have been the first occupation of the earliest of the race, and the shining pearl would thus have been discovered in river mussels if not in marine oysters. Certain it is that the Old Testament and the most ancient written histories allude to pearls, and that remoter evidence is found in the tombs and excavated cities of still earlier eras. The Egyptians, Babylonians and Assyrians held the pearl in an esteem verging on reverence.

Not only were pearls known and prized as the most precious of gems, but they were gathered and treasured in astonishing quantities by the early Oriental potentates. Many relics and records of those days remain. The crown of the Khan of the Tartars, captured on the Oxus by the Persians in the fifth century, was decorated with several thousand pearls. The famous crown of Chosroes, made in the sixth century, and which was strangely concealed for a thousand years in an obscure fortress among the Lauristanian Mountains, till brought to light by Shah Abbas, is incrusted with pearls in conjunction with rubies. In the seventh century the Arabs captured from the Persian nobles fabrics of amazing richness, among which was one marvelous carpet of white brocade, four hundred and fifty feet by ninety feet, with a border worked in precious stones to represent a garden of all kinds of beautiful flowers—the leaves of emeralds and other green gems, the buds and blossoms of pearls, along with rubies and sapphires.

The treasures of the Turkish nobility during some of the more brilliant reigns of the empire seem to belong to fable rather than to veritable history. Sinan Pasha, dying at eighty, left fifteen

strings of enormous pearls, and of "fine pearls" no less than sixty bushels!—accumulated during campaigns in Europe, Asia and Africa.

Sh'ah Jehan, greatest of Mogul sovereigns after Timour, collected the wealth of India about him at Delhi, including the world-famous diamond known ever since as the Great Mogul. His was the famous peacock throne, the spread tails of the peacocks formed of precious stones to emulate the colors of the living bird, the whole valued at nearly thirty-five million dollars. Its canopy was fringed with pearls. His, too, was the Taj Mahal, the most marvelous tomb ever built, on which twenty thousand men worked for more than twenty years. And this Shah Jehan loved to wear round his neck priceless strings of immense pearls.

The Greeks and Romans rivaled the Orientals in their appreciation of pearls. When Alexander and his eighty companions wedded their beautiful Persian brides at the most famous marriage feast of history, the pearls of the Persian Gulf were the favorite jewels—as they are with brides in this closing decade of the nineteenth century. The Romans sent caravans on yearlong journeys to Ceylon for pearls. And there is evidence that Julius Cæsar really invaded Britain for the sake of expected plunder in pearls. That he was not disappointed is shown by the record that on his return he dedicated to the Venus Genetrix a breastplate of the British gems.

The ancients seem to have had no conception of the real origin of pearls. Even in the days of the Romans they had not advanced beyond the early myths of creation by Vishnu, of angels' tears dropped out of heaven into the gaping mouths of mussels, or the diverse theory that they were as mystically congealed from dewdrops, which with equal mystery, after their ethereal descent, dropped through fathoms of water without commingling—unless, indeed, the shellfish were supposed to come to the surface to receive them. Pliny gravely asserts that "pearls are great or small, better or worse, according to the quantity and quality of the dew they have received. For, if the dew were pure and clear that went into them, then are the pearls fair and orient. Cloudy weather spoils their color, lightning stops their growth, and thunder makes the shellfish eject hollow husks or bubbles" in place of pearls.

Ceylon and the Persian Gulf, which were the chief sources of fine pearls back before the dawn of the Christian era, have retained their supremacy through twenty centuries, though profitable pearling grounds are now worked in Eastern waters off New Guinea and the northern Australian coasts, in the Sulu Archipelago, off Japan, and among the Polynesian islands. In minor quantity, and perhaps quality, pearls are gathered from Western

waters off the coasts of equatorial South America, the West Indies, Panama, and southern California. The Aztec kings possessed pearls of great beauty and price, obtained, it is supposed, from Panama. The palace of Montezuma, when despoiled by the Spaniards, is described as "studded with pearls," along with emeralds.

Some fine pearls are produced in inland waters by the fresh-water mussel (*Unio margaritifera*). Most of the river pearls are found in China, though at some periods the pearl industries in England and Scotland have been important. The rivers of Germany and parts of Russia are also pearl-producing. The principal river-pearl fishery in the United States is in the Little Miami in Ohio.

The marine mollusks yielding pearls are the *Avicula* (*Meleagrina*) *margaritifera, Avicula macroptera,* and *Avicula fucata.*

In the Persian Gulf the *Avicula fucata* is specially fished for gem pearls, as it produces more and of finer quality than the other varieties, though it is smaller and of less value for the mother-of-pearl lining of its shell. All three varieties mentioned, however, are found on the famous Great Pearl Bank, which lies along the west coast of the gulf. There the pearling industry from remote times has so dominated the people that it has passed into a proverb, "All are slaves to one master, Pearl."

The great Ceylon pearl fisheries are now a monopoly, under the supervision of the British Government, as formerly under that of the Portuguese and the Dutch. The fishing seasons occur at irregular and infrequent periods, only half a dozen having been sanctioned by the inspecting officer in the quarter century between 1863 and 1887. The value of the pearls from these several fishings varied from fifty thousand to three hundred thousand dollars, with a total of about one million dollars. The Ceylon fishing season runs from four to six weeks. The latest of which there is data was that of 1889, when in twenty-two days fifty divers brought up eleven million oysters, which yielded the Government fifty thousand dollars and the divers about fifteen thousand dollars. In Ceylon it is the custom to land the cargoes of oysters on the shore to die and decay. When sufficiently decomposed they are opened and then washed and searched for the more valuable loose pearls, after which the *boutons* are clipped from the shells, and the larger of the shells themselves selected for their mother-of-pearl.

Diving for pearls is perhaps the most perilous of occupations, with the possible exception of its antithesis—that of aëronautics. There are the terrible physical tortures of the first descents from the pressure of water; the bleeding from nostrils, ears and mouth; the bursting of small blood-vessels in the lungs; and the

rending of a way from ear to nasal passage. Nearly all divers become partly or totally deaf. Incipient heart and lung troubles are quickly developed to a fatal end. Paralysis is often induced. Sharks occasionally devour the naked natives; such tragedies are not common, however, since the splashing and constant agitation of the water serve to keep them at bay—though, no doubt, the natives themselves would credit their immunity to the shark-charmer who accompanies each boat.

The native crews off Ceylon usually include ten divers, five of whom rest while the other five are diving. Each man has a diving stone, weighing perhaps forty pounds, to which is attached a rope long enough to reach the bottom, and having a loop for the foot. The diver slips his foot into the loop at the sinking stone, inhales a full breath, compresses his nostrils with his left hand, raises his body as high as possible, and sinks swiftly to the bottom, feet foremost. The average depth for native divers is fifty feet, the greatest depth about seventy-five. The naked diver must work with great rapidity, as he can remain at the bottom only about fifty-five seconds. In spite of stories of divers remaining below for three or four minutes, the best divers rarely reach eighty seconds, and few exceed sixty. In this brief period such shells as can be secured are thrust into the shell-bag, net, or basket, the tender in the boat is signaled by the line attached, and the diver assists his own ascent by seizing the bag line as it is drawn up.

In the Persian Gulf the ancient custom of stopping the ears with cotton saturated with oil and closing the nostrils with pincers of tortoise shell is still in vogue. But the primitive method of diving is now being superseded by scientific diving in the modern diving dress. This consists of a rubber-cloth suit in one piece from foot to neck. The hands are bare, the elastic wristbands of the dress hugging tight enough to exclude water. The neck is large, of course, to admit the body after the feet and legs. The diver once in this dress, the neck is fastened between the double rims of a brass corselet, and then a big copper helmet is set over the head and screwed to the corselet. The helmet has glass windows at each side and in front, an air-tube entering at the back through which air is supplied by a pump worked by a couple of men in the boat, and a valve at the side for the outlet of vitiated air. The armored diver wears leaded canvas or leather boots weighing fifteen or sixteen pounds, and a couple of heart-shaped leaden plates over chest and back weighing twice as much more. He has a life-line fastened to his right foot and then by a slip-noose about his waist. This life-line is held by a "tender" in the boat who answers signals: one jerk, pull up; two, more air; three, lower bag.

The armored divers are mostly white sailors, Germans, Swedes, a few English, and an occasional American; and so great is the advantage of the diving suit that one armored diver is considered equal to a whole crew of natives. Instead of a swift, breathless struggle of fifty or sixty seconds, at a depth of fifty feet or less, with a limit of seventy-five, the armored diver can work for ten minutes at a depth of a hundred feet, while at a depth of thirty he can work for a couple of hours. The deep-sea dangers to which the naked diver is exposed are mostly shared by the armored diver. The protection from the tremendous crushing pressure of the water afforded by the suit and the cushion of inclosed air is offset by the increased pressure at greater depths. The armored diver likewise encounters the venomous stonefish. This little fish punctures the hand reaching for a shell and injects a poison which causesthe whole arm to swell, with great pain. The remedy is to remain down, as the pressure of water induces free bleeding at the wound, and the consequent outflow of the poison. If the bitten diver comes to the surface, as the unarmored diver must, the arm swells rapidly, turns black, and is painful for weeks.

Sharks do not attack the armored diver, but he has peculiar perils which the naked native diver escapes. At some great depth the air-pump may not work, or the air-pipe may burst. But there are greater dangers yet. Pearl oysters are not found in beds, like our edible bivalves, but scattered over the sea bottom; hence it is the custom to beat up against the tide or current, and then let the lugger drift, with a drag-anchor perhaps. Yet sometimes the drifting boat is seized by a strong current and whirled along, and then, while the diver hurries on to keep up, his life-line or air-pipe may become fatally entangled in branching coral; or, again, a slack line or pipe may fall into the jaws of the "giant clam," which close over it, and hold the diver prisoner to his death, alone in the dim ocean depths.

The most perfect pearls are found within what is called "the mantle" of the mollusk, an elastic membrane which envelops the oyster, and which is supposed to secrete the nacreous fluid. The finest specimens lie near the lips of the shell, or are imbedded in the softer part of the oyster near the hinge of the shell. The ideal gem pearl is spherical, white, without blemish in texture or "skin," with pure "water" or appearance of transparency—though no pearl is really transparent—and of distinguished lustre or orient. Lustre is the soul of the pearl, as brilliancy is of the diamond. Finely formed drop shapes, and then oval or egg shapes, are but little below the spherical pearls in value, if of equal perfection. The fine gem pearls are the size of peas; very much larger specimens, of twenty-five grains and upward, of perfect quality, are rare, and command corresponding values.

At the breaking up of the French crown treasury in 1791, a superb spherical pearl of large size sold for forty thousand dollars, and two pear-shaped pearls, weighing two hundred and fourteen grains, were valued at thirty thousand dollars each. The Shah of Persia possesses one of the finest pearls in the world, worth three hundred thousand dollars. The Imam of Muscat has refused one hundred and fifty thousand dollars for one of his famous gems. Perhaps the most extraordinary pearl now known is in Mr. Beresford Hope's collection in South Kensington; it is two inches long, four in circumference, and weighs eighteen hundred grains.

When Rome ruled the world, a wonderful pearl worth four hundred thousand dollars was cut in halves for earrings for the Venus in the Pantheon. The pearl of the Cleopatra legend is said to have been of equal value—though if swallowed it must have been as a pill without sugar coating, since gem experts assert that no acid the human stomach could endure will dissolve a pearl; indeed, the most powerful acids known only discolor and destroy the outer layers of nacre after long immersion. Authorities do not agree upon this point, however.

While the white pearl is really the ideal pearl of all ages, fashion, local in place and time, has favored other colors for the hour. Rose-colored pearls have been the fad in Paris for several seasons, to the enriching of the Scottish fishers. The Chinese prize yellow pearls; and just now black pearls, if of perfect quality, command the highest price. The largest and finest black pearls come from the La Paz pearling grounds off Lower California, which also yield pink pearls.

The color of pearls, as well as the quality and especially the lustre, depends on the peculiar environment of the oyster, the chemical composition of the water. The inky fluid ejected by the great squid is believed to affect the color of pearls. Temperature and the health of the mollusk may modify the nacreous deposits. Be all this as it may, when the oyster ranches already alluded to shall be established on our California coast, we may well expect that, with the co-operation of chemical and biological science, marvelous results will be obtained in both the quality and color of pearls—any color being produced at pleasure. Women of fashion and wealth will then order their pearls a season ahead, to be grown of desired form, lustre, and color, to harmonize with their gowns, as to-day they order in advance the gowns themselves.

Artificial pearls, which only the expert is likely to detect, are made by coating the inside of thin glass spheres with a solution of liquid ammonia and the lustrous coating of the lower scales of the bleak and dace, filling the bulb with melted wax,

and then subjecting the surface to the action of hydrofluoric acid. This was the invention of Janin, Jacquin, or Jalquin, a rosary-maker in Paris, in 1680. A thousand fish yield less than an ounce of the "pearl essence," which is correspondingly costly. The cheaper so-called Roman pearls have a lustrous coating on the outside, but bear little resemblance to real pearls, or even to the artificial pearls just described.

Considering the vast values in gem pearls obtained from the Eastern fisheries, it is surprising to find that the plain, unromantic mother-of-pearl secured is of even greater worth. Previous to the discovery of the extensive Australian fishing grounds, in 1865, the supply of mother-of-pearl was diminishing, while the demand was increasing. The large-shelled species already mentioned are there found in fine quality. The shells are the size of large soup-plates, weigh a pound each, and are worth about a dollar a pair. An expert diver, in diving dress, will collect three or four hundred pairs in a day. About a hundred gem pearls are found in every ton of these shells.

Beautiful art work in carved and inlaid mother-of-pearl has long been produced in China and Japan. Some idea of the extent of its European use in the arts and manufactures may be had from the fact that eight thousand people are engaged in working mother-of-pearl in Austria, and half that number in France, while the value of the annual import into England is nearly one and a half millions. In the Philippine Islands windows are made of mother-of-pearl; and James Anthony Froude, in his volume of voyaging in Oceana, describes frightful Maori idols with slips of mother-of-pearl glittering in their eye-sockets; while in Cashmere it is the custom to inlay the inscriptions in tombstones with the same exquisite substance. To cap the climax of curious uses of the lustrous nacre, it is said that large quantities of seed pearls are imported into China to be calcined into medicines for the Celestials.

According to M. Brau de Saint-Pol Lias, the Society of Arts and Sciences of Batavia has given special attention to the reconstitution of the most ancient of the Oceanican languages, the Kawi, which is probably the mother language of all the region. The Kawi inscriptions, in which William von Humboldt was much interested, are found everywhere in the islands; on the rough cliffs, on cut stones, buildings, statues, plaques of gold and silver, coins and medals; and many grand ruins of its people are found in Borneo, Sumatra, Bali, and especially Java. The language is still preserved in the legendary songs of the Javanese, as they are sung in their theaters, although it is not understood. Through the studies of the Batavian scholars the alphabet has recently been deciphered, and the meaning of two hundred words out of five hundred determined, while one hundred words are still in doubt, and two hundred are wholly undefined.

SKETCH OF JACOB MOLESCHOTT.

By Prof. E. P. EVANS.

THE distinguished physiologist, Jacob Moleschott, was born August 9, 1822, in Hertogenbush,* the capital city and chief commercial and industrial center of North Brabant in Holland. His father was a physician of some note, and his paternal grandfather a reputable apothecary; on his mother's side he was the grandchild of the celebrated Dr. Van der Monde. His mother was a woman of superior culture and refinement, and she and her more sedate and scientific husband devoted themselves with conscientious care and excellent discretion to the early education of their child.

The Moleschotts were originally Catholics. In 1797 the grandfather's dwelling, together with his large apothecary shop and storehouse, which contained a hundred thousand florins' worth of Peruvian bark and other medicaments of great value, was burned to the ground, thus reducing him at once from a state of affluence to extreme poverty. Not one of the many priests, who had constantly enjoyed his generous hospitality, lifted a finger to help him in his distress. A few prominent Protestant citizens came to his aid, and by their timely efforts enabled him to resume his business, which he carried on with such success as partially to retrieve his fortune, so that when he died in 1838 he was a comparatively wealthy man. The unsympathetic conduct of his coreligionists made a deep impression upon him as well as upon his son, who was then a child, and instead of pursuing his studies at the Catholic seminary at Warmond, he entered the University of Leyden, to which he was especially attracted by the eminent humanist, Prof. Daniel Wyttenbach, a man as conspicuous for learning as for breadth and freedom of thought. The influence exerted by this liberal thinker and scholar was wholesome and permanent, and decisive in determining the future intellectual character of the Moleschott family.

In his fifteenth year Jacob Moleschott was sent to the Prussian gymnasium at Cleves, not far from the Netherlands frontier, where he remained five years. He was then matriculated as a student of medicine and natural science in the University of Heidelberg.

At the solicitation of Nägele, Moleschott prepared a dissertation on a pathological problem which had been already discussed by the professor, but which could be definitely solved only by the

* ['S Hertogenbosch (the Duke's Bush) was originally a hunting seat of the Dukes of Brabant; hence the name.]

aid of the microscope. The difficult task was performed to the entire satisfaction of Nägele, who took occasion to express it in a peculiar manner. As Moleschott was returning for the first time from clinical practice in the lying-in hospital, for which he had paid the required fee to the secretary, Nägele accompanied him, and, as they were going downstairs, stuck the amount of the fee into Moleschott's vest pocket with the remark, "*Clericus clericum non decimat* (Clergy does not take tithes of clergy)."

In 1844 the Teyler Society of Harlem offered a prize for the best dissertation on Liebig's theory of the nutrition of plants, which formed the basis of his application of chemistry to agriculture, and which at that time excited as lively discussion in the scientific world as did Darwin's theory of the origin and evolution of species fifteen years later. Moleschott took a deep interest in the subject and was urged by Delffs to compete for the prize, which was also awarded to him. His dissertation contained a thorough examination and keen analysis of Liebig's views, and pointed out some instances of hasty generalizations and unwarranted conclusions. Moleschott exposed these logical fallacies and showed how largely they entered into the reasoning and vitiated the deductions of the distinguished chemist. The copy of the prize essay sent to Liebig was accompanied by a note in which Moleschott, while venturing to criticise his views, expressed the warmest admiration and enthusiasm for his personal character and scientific achievement. Liebig replied, thanking him for the essay, and added: "So far from being offended by opposition, I desire it, since it serves to separate the grain from the chaff; and I have all the more reason to be satisfied when this is done, as in your case, in a clever and gentlemanly manner."

On January 22, 1845, Moleschott passed his examination, and was promoted to the degree of Doctor of Medicine, receiving the first rank. But in order to practice his profession in Holland it was necessary to have a certificate of proficiency also from a Dutch university. For this purpose he went to Leyden, where he passed the so-called *colloquium doctum*, which consisted in a pleasant conversation with professors of the medical faculty—Broers, Pruys van der Hoeven, and Suringar—on the endemic diseases of Holland. He then established himself in Utrecht.

In connection with Donders and a Jewish physician, Van Deen (afterward professor in the University of Groningen), Moleschott founded a scientific journal for the publication of the latest researches made by Hollanders in anatomy and physiology, to which Mulder, Harting, Jansen, Van den Broek, Kees Verloren, Eduard von Baumhauer, and others sent valuable contributions. Notwithstanding the congeniality of many of his associations and his interest in these investigations, he was not contented with his life and

prospects in Utrecht. One day a Protestant clergyman paid him a visit and, after speaking in flattering terms of his professional ability and success, expressed regret that Moleschott did not attend church, and promised, on this condition, to recommend him to the members of the congregation. Moleschott thanked him for his good opinion and kind intention, but positively declined to pretend to worship God in the service of Mammon.

Moleschott's predilection for scientific research became more and more a passion to him. He determined henceforth to make a specialty of the study and teaching of biology in the broadest sense of the term as the science of life, and for this purpose habilitated as *Privatdocent* in his *alma mater*, the University of Heidelberg. No sooner was his intention made known than he was offered the position of Lecturer on Medical Jurisprudence in the University of Utrecht, which, however, had no attractions for him.

The subject chosen for his first course of lectures at Heidelberg in the summer of 1847 was physiological chemistry, and, although his audience was small, it comprised a number of students who afterward became scientists of distinction. As the fees for lectures furnished only a scanty source of revenue, he was compelled to keep up a limited medical practice and to devote himself earnestly to literary work. One of his first tasks of this kind was a thorough revision of the volume on foods in Prof. Tiedemann's elaborately planned but unfortunately never completed Manual of Human Physiology, which he undertook at the request of the venerable author.

On March 14, 1849, Moleschott married Sophie Strecker, the eldest daughter of a prominent citizen of Mayence, who entered heartily and intelligently into her husband's special studies and proved to be an efficient helpmate in catching and preparing frogs for experimental purposes, and aiding him in his microscopical observations.

In a course of lectures on the blood and its constitution, especially as to the effects of different kinds of food upon the relation of the white to the red corpuscles, Moleschott was assisted by seven students, who volunteered to undergo the necessary experiments. They came in the morning without having eaten anything and then partook of the prescribed diet, whose nutritive qualities were to be tested by an analysis of the blood. If eggs and other albuminous fare, roast meats, and peas were served, all was well; but if the meal consisted merely of potatoes and apple sauce, the youthful votaries of science, after their work was done, returned to their homes with ravenous appetites and pillaged cupboards and kitchens, so that the cooks in their respective families began to gossip about the queer sort of hospitality shown by that Dr. Moleschott, who invited the young men to dine with him and

insisted that they should come with empty stomachs, and then sent them home as hungry as wolves. About this time he also succeeded in demonstrating that frogs exhale more carbonic acid in the light than in the dark, thus proving that light accelerates the processes of assimilation in animal organisms, and that, too, independently of the temperature of the environment or the motion of the animal.

Meanwhile he had prepared and published his *Lehre der Nahrungsmittel* (Erlangen: Enke, 1850). This work, of less than two hundred and fifty pages, written "*für das Volk*," and admirably adapted to convey popular information concerning the digestive qualities and nutritive properties of common articles of food, was favorably received, and in a few years passed through three editions. It presented in a clear and concise manner the results of researches embodied in his *Physiologie der Nahrungsmittel*, issued a few months earlier and intended for physicians and naturalists, and was translated into Dutch, English, French, Italian, Spanish, and Russian. It is divided into three principal parts, the first of which treats of the general metamorphosis of matter in living organisms, the origin and formation of the blood and of the solids in the human body, the processes of assimilation, segregation, and excretion as the conditions of growth, and the physiological nature of hunger and thirst as sensations which inform the brain through the medium of the nerves that the blood is being impoverished. In the second part he shows how this impoverishment is checked and the waste repaired by nutriment, of which the various kinds—meat, eggs, bread, cake, peas, beans, lentils, potatoes, beets, cabbage, and other vegetables, and different sorts of fruit—are discussed as to their alimentary functions and value. We then have a chapter on drinks—water, milk, tea, coffee, chocolate, beer, wine, and brandy—and another on spices, or rather on condiments, in which are included not only salt, pepper, mustard, ginger, and other spices, but also butter, olive oil, vinegar, sugar, and cheese. In the third part there are rules of diet in their application to man as a not strictly omnivorous, but largely multivorous microcosm, with remarks on breakfast, dinner, and supper, nutriment for infancy, youth, middle life, and old age, for women, workmen, artists, scholars, and other persons of sedentary habits, and the different sorts of food suitable for summer and winter. All these points are discussed in a series of short sections with a perspicacity and perspicuity and power of condensation rarely combined in scientific treatises. This feature of the work was especially praised by Alexander von Humboldt.

Perhaps even a greater sensation than by the book itself was made by a long review of it in a Leipsic weekly journal (*Blätter für literarische Unterhaltung*, November 9, 1850), by Ludwig

Feuerbach, who summed up its teachings in the pithy phrase, "*Der Mensch ist was er isst*" ("Man is what he eats"). A similar utterance is that with which Moleschott closes the chapter on the nutritive properties of leguminous plants: "*Ohne Phosphor, kein Gedanke*" ("Without phosphorus no thought").

Moleschott's book had a socialistic as well as a scientific character, although this feature was hardly recognized by his contemporaries and critics. It indicated the direction which European legislation is now taking to solve the social question, namely, through the stomach, by making better and surer provision for the present and future wants of the working classes.

About eighteen months later Moleschott published his *Physiologie des Stoffwechsels in Pflanzen und Thieren* (Erlangen: Enke, 1851), of which Humboldt, in a letter dated November 30, 1851, expressed his warm appreciation and hearty indorsement. This work, however, was only preliminary to another of wider scope, entitled *Der Kreislauf des Lebens: Physiologische Antworten auf Liebig's chemische Briefe* (Mainz: Zabern, 1852; fifth edition, 1887), consisting of a series of twenty letters on revelation and natural law, with strictures on Liebig's confusion of these conceptions, the sources of human knowledge, the eternity of matter, its gradual evolution, constant circulation, and endless transformations in the growth, decay, and renewal of animal and vegetable life; force as an essential and inseparable quality of matter, especially as regards the functions of the brain in their relations to the faculty of thought and the freedom of the will, and kindred topics.*

In the practical application of his theories Moleschott animadverted on the prevailing custom of burying the dead in permanent cemeteries, where their bodies decay with no advantage, and often with serious injury, to the living. "If every place of burial," he says, "after having been used a year, should be exchanged for a new one, it would become in the course of six or ten years a most fertile field which would do more honor to the dead than mounds and monuments." But, he adds, it would be still better if we could return to the ancient custom of burning the dead, which he declares to be unquestionably more practical as well as more poetical. By this process the air would be made richer in carbonic acid and ammonia, and the ashes, which contain the elements of new crops of cereals for the nurture of man and beast, would transform our barren heaths into luxuriant plains. At present, he adds, we are acting like the stupid and slothful servant who buried his one talent in the earth instead of wisely investing it so as to gain another.

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* The latest editions of Moleschott's works, his *Kleine Schriften* (Minor Essays), *Vorträge* (Addresses), etc., are now published by Emil Roth in Giessen.

These views, while commending themselves to naturalists like Humboldt, Donders, Van Deen, Emil Rossmässler, Otto Ule, and Hermann Burmeister, and scholars like Strauss and Renan, gave great offense not only to the orthodox clergy but also to conservatives of every sort, to whom the cremation of the human body seemed as sacrilegious as its dissection did to the contemporaries of Vesalius three centuries before. As the result of a solemn conclave held by the senate of the Heidelberg University, the rector of that institution warned Moleschott that, unless he ceased to corrupt youth by his "immoral" and "frivolous" teachings, the *venia docendi*, or right to lecture, would be revoked. The sole fitting answer to such an ill-advised and impertinent admonition was given at once by Moleschott, who wrote to the Baden ministry severing his connection with a university in which liberty of instruction existed only in name. This decisive step was evidently an unpleasant surprise to those who had provoked it, and thereby raised a storm of indignation in scientific circles and in the press which they were wholly unprepared to meet. The young men who had just attended Moleschott's courses of lectures on anthropology and organology published with their several signatures an address to the ministry, in which they vigorously repelled these accusations and vindicated Moleschott's character as a man and teacher. In their daily intercourse with him they declared that they had never detected the slightest justification of the charges brought against him. In the communication of the results of his scientific researches there was not the faintest trace of the spirit of proselytism, but every one was left free to form an independent judgment in accordance with the facts.

Although no longer an academical teacher, Moleschott continued to reside in Heidelberg, working in his private laboratory, to which he also freely admitted all who wished to make experiments under his direction, and keeping his head financially above water by literary labor. Thanks to his calumniators, public attention was called to his books, and the sale of them greatly increased. He also founded a scientific journal entitled *Untersuchungen zur Naturlehre des Menschen und der Thiere,* which began to appear in 1855 at irregular intervals, and numbered among its contributors some of the most distinguished European men of science. Moleschott edited the first fifteen volumes of this periodical, or year-book, as it might more properly be called; since 1892 it has been continued by G. Colasanti and S. Fesbini (Giessen: Emil Roth). He also published an exceedingly interesting monograph, *Georg Forster, der Naturforscher des Volks,* issued November 26, 1854, on the hundredth anniversary of the birth of this most remarkable man.

In the spring of 1856 Moleschott was appointed to the chair of Physiology in the University of Zurich as the successor of Karl

Ludwig, who had been called to Vienna. On June 21st of the same year he delivered his introductory lecture, the subject of which was Light and Life. It was printed as a pamphlet, which went through three editions. On his way to the lecture room he met the rector of the university, Hermann Köchly, who was not only an acute philologist but also something of a wag, and who assured him that the peasants, led by their pastors and armed with clubs, were coming down the lake to put a stop to such godless proceedings, just as a dozen years before they had overthrown the government that ventured to offer a professorship to David Strauss.

At that time the society of Zurich was uncommonly attractive, owing in a great measure to the presence of many political refugees from France, Germany, and Italy, whom the reaction which followed the Revolution of 1848 had driven into exile. Very pleasant, too, and stimulating were his associations with G. H. Lewes and George Eliot, who came to Zurich on purpose to visit him; with Varnhagen von Ense, Gottfried Keller, Princess Wittgenstein, Countess d'Agoult, and especially the geologist Eduard Desor, at whose country seat in the Jura, Combe-Varin, a select circle of congenial spirits met from time to time for the interchange of thought and the discussion of scientific questions. Among those who were wont to assemble under Desor's hospitable roof besides Moleschott may be mentioned Carl Vogt, Charles Martin, Jacob Venedey, Liebig, Schönbein (the discoverer of guncotton), Dr. Hans Küchler (a German Catholic parson), and Theodore Parker, who spent the summer of 1859 in the Alps for the benefit of his rapidly failing health. At these meetings papers were read, and Moleschott speaks in the highest terms of one by Parker, entitled A Bumblebee's Thoughts on the Plan and Purpose of Creation, an exceedingly acute and amusing persiflage of the anthropocentric theory of the universe. These essays form the contents of Desor's Album of Combe-Varin, a unique memorial volume of about three hundred pages. Moleschott and Parker often differed in their ideas, but entertained the warmest regard for each other as earnest and honest seekers after truth. Curiously enough, a peculiarly strong attachment sprang up between Parker and Küchler, the radical Unitarian and the German Catholic, who used to sit for hours in conversation under an evergreen tree, a fit symbol of their lasting friendship and now known as "Parker's Fir." *

* Moleschott's charming autobiography, *Für meine Freunde* (Giessen: Emil Roth, 1894, pp. 326), gives a pleasant account of the days spent with Desor and his illustrious guests at Combe-Varin. Indeed, these personal reminiscences are most delightful reading, and it is to be regretted that they have remained a fragment extending only to 1860, and thus comprising but a little more than one half of his life. The life at Combe-Varin is also described in Alfred Altherr's *Theodor Parker, in seinem Leben und Werken* (St. Gallen:

In the autumn of 1861 Moleschott was called by Cavour to the chair of Physiology in the University of Turin. In 1876 he was made senator of the kingdom of Italy, and in 1879 appointed to a professorship in the newly organized University of Rome, where he united with his academical duties and senatorial functions an extensive practice as a physician. There he died, May 20, 1893; and, although more than threescore years and ten, he was constitutionally so robust that his death may be said to have been premature. Like his father, he fell a victim to overwork and exposure in the conscientious exercise of his profession. During the last twenty years of his life he devoted himself also with laudable zeal and marked success to the land of his adoption in the promotion of education and the sanitary improvement of the Italian capital and other cities of the realm.

Moleschott was not only an able and painstaking specialist but also a man of broad culture, an excellent musician, a connoisseur in art, and a keen observer and intelligent critic of all the social, political, philosophical, and theological movements of the age. Whatever concerned the progress of knowledge and the perfection of humanity enlisted his sympathies and secured his support. He was a good linguist, and wrote and spoke French, Italian, and German with rare correctness and facility. The greater part of his works were composed originally in German, which he preferred even to Dutch, his mother tongue, as a medium of literary and scientific communication; but, unlike most German authors, his style is wonderfully clear and succinct, and wholly free from the awkward involutions into which the peculiar genius of the language, its very vitality and plasticity, are apt to tempt the unwary scribe. Moleschott was saved from this fatality by his artistic sense of proportion. In his treatment of a subject he had the rare gift of knowing what to put in, what to leave out, and when to stop. He was a "full" man, in the Baconian use of the term, but was mentally too well poised to slop over. He had inherited a hasty temper, but had learned in early life to keep it under control, and this natural sensitiveness under proper discipline rendered him a most charming and sympathetic companion in his intercourse with his family and his friends. Above all, he was thoroughly honest and sincere, and never permitted personal feeling to warp his judgment; in his controversies and criticisms he was generous and just, welcomed the truth from every source, and did not show the slightest disposition to ignore or depreciate the merits and achievements of an adversary.

Wirth, 1894, ix, pp. 404). The author is the pastor of St. Leonhard's Church in Bâle. We may add that photographs of Moleschott, of a cabinet size, may be procured from his publisher, Emil Roth, in Giessen, for one mark, or twenty-five cents.

Correspondence.

CHARACTER-BUILDING AND THE ENVIRONMENT.

Editor Popular Science Monthly:

SIR: Your editorial entitled Necessity, in the April number of the Popular Science Monthly, attracted my attention, and as a general statement this much of your conclusion commands my approval: "In every well-balanced mind the thought of necessity is habitually present, calling forth efforts of self-restraint which tend to conserve and consolidate the individual's happiness and well-being. We contemplate, therefore, a constant recognition of necessity, but a recognition which enables a man to meet it on ground more or less of his own choosing."

Your more special conclusion, however, does not appeal to my reason as having any great value as a *practical* proposition. I refer to the following: "The problem is to make more sound individuals; and that problem does not seem to be in its nature insoluble—therein differing from some that are set by social reformers." The value of this proposition depends wholly upon the meaning of the term "sound individuals." If in defining this expression you include as an essential characteristic of "sound individuals" a knowledge of the meaning and application of the law of equal freedom, as taught by Herbert Spencer, your proposition is of unquestionable validity; although it would still be of no great *practical* value without pointing out the *specific* manner of making individuals sound relative to the particular necessity they have to face; the necessity which you appear to have had in mind in this case being their social environment.

You say: "Socialist writers do not appear to be at all of this way of thinking. They have a noble zeal for remedying evils, but they do not seem to allow anything for the conditions which Nature itself imposes." This is a blunder for which defenders of our present semi-socialistic society are equally responsible. There is no more imperative and unchangeable condition imposed by Nature than the law of rent. Henry George has shown, in Progress and Poverty, that private appropriation of rent is the world-wide cause of involuntary poverty. His book has been before mankind nearly twenty years, and there is not to-day a review of it extant worthy of being classed under the head of scientific investigation and criticism. All attempt at criticism of Progress and Poverty *as a whole* is mere pettifogging.

Rent is a social product. The exclusive possession of land is a special privilege granted by society. Society should realize one hundred cents on a dollar for its resources. Instead of so doing, it squanders them, gives them away. In throwing away its resources Government pursues a course that would bankrupt any private business. But, unlike private individuals, it has the power to recoup its losses by force, by preying upon individuals—taking their property without giving anything in return. In so doing it violates all the laws of equity and propriety fully recognized in private transactions. Men in dealing with each other give value received, or at least make a pretense of so doing. Government, however, does not even make the pretense, but takes our personal property by force without even claiming that the tax is in proportion to benefits conferred.

But this is the will of the ignorant majority, also of pretentious scientists and teachers of *morals*. My first prescription for making "sound individuals" is to teach them the good old maxim, "Equal rights to all, special privileges to none," and then to show them the *application* of this principle to society's administration of the land.

Your criticism of socialism, and any scheme whereby employers would be *compelled* to hire the unemployed, is valid. Single taxers, however, ask only that the unemployed have *equal access* to natural opportunities. Granted that those having more capital can make better use of natural opportunities, but where does capital itself come from? With *equal access* to the land, whence capital is derived, men would quickly employ themselves, and would soon provide themselves with capital; if they did not, they could make no reasonable complaint.

You say: "The more, for our own part, we look into these questions, the more we are driven back to the conviction that the way out which is so much desired lies in the improvement of individual character, with consequent increase of individual power and better adaptation to surrounding conditions. As it is, we find that the well-developed individualities can take care of themselves pretty well; they have the power of adapting themselves to their surroundings, and taking so useful a part in the world's work that, even under the much-abused capitalistic system, they thrive very well."

When men arrive upon this earth, as millions do, and find it owned and their right to equal access to it denied, they are undeniably at about as great a disadvantage as it is possible to conceive; and it is worse than mockery to tell them that "the way out

which is so much desired lies in the improvement of individual character, with consequent increase of individual power and better adaptation to surrounding conditions." The thing to tell them is *to change the surrounding conditions so as to remove the disadvantage.* It is true that a small percentage of well-developed individualities, especially if they manage to get possession of some of the special privileges created by law, thrive very well; but this percentage is so small as to be hardly worth considering when studying the welfare of the human race.

You advocate the doctrine of contentment. You would say that an engineer, for example, obtaining for his services five thousand dollars per annum, was thriving very well. Perhaps another person, utterly regardless of his *natural* individual power, is in possession of an income of one hundred thousand dollars per annum, derived solely from special legal privileges, without rendering any service to society. The latter represents a class who are parasites upon the former. The question is, *How much better would the engineer thrive if the legal privileges supporting the parasite class were abolished?* Another question suggests itself. Suppose a large number of the individuals of low productive power should follow your advice and become, for example, competent engineers, how well *then* would good engineers thrive? Would not competition immediately bring down the incomes of engineers? The privileged classes would simply have better educated servants, and would get them for less pay.

You say: "We are far from saying that there is not a vast amount of hardship in the world, and much of it of a kind which in no way benefits those who have to endure it, as, of course, some hardship undoubtedly does. But we want to see a way out that will not cut the nerves of industry and make self-reliance a forgotten virtue. We want to see a way out that will not lessen the sense of individual responsibility or make a man less a man. Show us such a way, and we shall gladly lend every effort in our power toward its realization."

The writer is very glad indeed to feel that he can give you credit for being sincere, and that your attitude toward the single-tax movement results from a misconception of it, notwithstanding the immense amount of circumstantial evidence pointing to the so-called "conspiracy of silence" of the press, due to its subjection to the privileged classes. Believing as I do that you greatly misconceive the single-tax proposition, I can not blame you for not offering its accredited representatives a full hearing in your conservative journal. In the interest of our movement and accepting your invitation, "Show us such a way," etc. I offer the services of myself and others in the movement to endeavor by private and confidential correspondence, or interviews if you prefer, to try to remove from your mind what we very plainly see are gross misapprehensions of our principles and aims. As a scientist you can hardly do less than give the subject this much consideration. As a journalist, however, we can not expect you to admit anything that you regard as visionary quackery. It is only in the hope that we may so far remove your misconceptions that you will see the propriety of admitting fair presentations of the single-tax proposition in your journal that I am writing you.

I am aware that very many of our advocates mix with their arguments a great deal of religious dogma and superstition and crude notions of "natural rights," etc. The writer, however, claims to be wholly free from these ideas and superstitions, and holds that they are entirely superfluous in presenting the single-tax proposition. I ask only for pure scientific treatment. If the single-tax doctrine can not be logically deduced from the accepted laws of political economy and ethics, or if it can be shown that the conclusions of those sciences invalidate the single-tax proposition, the writer stands ready to abandon it. Yours, etc., L. G. Bostedo.

Chicago, *April* 12, 1896.

Editor's Table.

SUMMER HOLIDAYS.

THE time is at hand for the annual migration from the city to the country or the seaside of all whose means enable them to allow themselves that pleasure. There is doubtless something more than fashion in the movement, for fashion is arbitrary and changeful, while the habit we speak of has been steadily growing in generality for the last half century or more. If we seek for the philosophy of it we may reasonably regard it as the expression of a periodical craving of human beings for closer contact with Nature than

the conditions of city life permit. The works of man, the monuments of civilization, in the end oppress us, and we turn for refreshment and expansion to the wider landscapes, the purer air, the freer life of regions as yet comparatively untamed. This is the most satisfactory view to take of the matter, and happily it is one of wide application. With many, however, there is no desire for an escape from the conventionalities of life, and no hunger for a reposeful contemplation of the beauties and grandeurs of Nature. The excitements of society may jade but do not satiate them, and, in their flight from the city to the seaside or mountain resort or to foreign lands, what they seek is still the excitement of society in new forms and under new conditions. With such we have no concern; no words of ours would be likely to reach the circles in which they move, nor, if they did, would they be in the least likely to secure a moment's attention.

Much benefit, in our opinion, is to be had from summer holidays if rightly used, and it can not but be a matter of regret to every sympathetic man and woman that so large a body of social toilers should be condemned to year-long imprisonment in the cities, varied only by such brief excursions to outlying points as the present improved conditions of local transit may place within their reach. The maximum of benefit from a holiday comes only to one who has earned it by faithful work. If, with mind and heart free, such a one can allow himself a few weeks' residence in some healthful spot where the face of Nature is beautiful with field and forest, with hillside and running water, he is a man to be envied. It is not inactivity of mind or body that a healthy man will desire on such occasions—inactivity is only for the exhausted—it is new occupation for mind and body combined with a delightful sense of not being in a hurry. The wise man cast amid natural scenery and conditions will seek in some way to enlarge his knowledge of and sympathy with Nature, not in the spirit of scientific research, but rather in that of loving contemplation. It is a time for increasing one's familiarity with natural objects, for learning a little more by direct observation of leaf and tree, of bird and insect, of cloud and mountain, for becoming more sensitive to forms of beauty and the changing harmonies of the visible world, for the unsealing of the eyes and the unstopping of the ears and the enlargement of the heart. From such intercourse with Nature, coupled with wholesome modes of life, there can not fail to flow much benefit, mental, moral, and physical. The mind gains in elasticity and apprehensiveness, the spirit in serenity, the body in tone and vigor, and summer holidays so spent are likely to prove the most fruitful part of the whole year.

It is the custom with some when they leave the city to lay in a stock of summer reading consisting chiefly of the "lightest" novels. This simply means that they still crave excitement, and must find it in ever-renewed pictures, however lazily gazed at, of the life of society—the life they have (in theory) left behind them. It seems to us that the books to take to the country, if we take any, are not new ones but old ones—those we have read before, but which still have their message and their charm, classics whose beauties we have not exhausted, and perhaps are not likely to exhaust, which recall old associations and help us to calmer and broader views of life. We lay down no rule for others; we merely suggest that there is more rest for the mind and spirit in going over old paths than in striking into new

ones. The new writers give us the last refinements and developments of thought, the latest paradoxes, and all that is up to date in style and expression; the old ones are better interpreters of primal Nature, and of what is broad and fundamental in humanity. In these pauses of life we should try to take to heart the lesson that Wordsworth teaches in his celebrated sonnet:

The world is too much with us; late and soon,
Getting and spending, we lay waste our powers;

and which a later poet echoes when he exclaims:

> The will to neither strive nor cry,
> The power to feel with others give;
> Calm, calm me more, nor let me die
> Before I have begun to live!

The Roman satirist Persius gives this pithy advice: "Dwell with yourself, and find out how little you really require." In our holidays it would be well, instead of pampering ourselves, to try to reduce life to its simplest, or at least to comparatively simple, elements. Thus can we best renew and rejuvenate our spirits, and bring ourselves to feel how little the joy of life depends upon the luxuries and artificialities of advanced civilization.

These are old ideas and have been much better expressed by many writers of note; but we are all apt to forget the good counsels we receive, and a timely reminder can do no harm. Particularly in a civilization so restless as ours and so avid of novelty, is a period of rest far from the hurry and turmoil of the city a matter of necessity. Otherwise what do we tend to become?—mere creatures of the moment, rushing from task to task or from amusement to amusement, hurriedly scanning the headlines of our papers or the illustrations of our magazines, constantly absorbed in the actualities and trivialities of life, and constantly tending toward a soulless materialism in thought and sentiment. If our civilization, however, is to count for anything serious in the great chain of human history, we must get more soul into it—we must strive to rise above the routine and mere mechanics of existence. We must find out and take the truth home to our hearts, that life is something more than meat, that the body is of more dignity than its raiment. and that the soul of man is destined for other and higher uses than simply to reflect the shows of the passing moment. Let us in our holidays, if we are so fortunate as to have any, try to baptize ourselves anew in the fresh fountains of natural beauty which almost every countryside affords, let us attune ourselves to the harmonies of Nature, let us get sight of our own souls, "our true deep-buried selves, being one with which," as one whom we all know has finely said, "we are one with the whole world."

MR. SPENCER AND THE METRIC SYSTEM AGAIN.

MR. HERBERT SPENCER is not one of those philosophers who think it a duty to hold severely and loftily aloof from practical and everyday questions. He is keenly interested in the daily life of the people in the widest sense of the word; and we may attribute to that fact the zeal he has recently displayed in connection with the proposition to make a radical change in the system of weights and measures now and for many generations established in England. Since we last referred to this subject Mr. Spencer has addressed two further communications to the London Times in relation thereto. The second of these we quote entire, as being a brief yet comprehensive statement, from the writer's standpoint, of the whole question.

THE METRIC SYSTEM.

To the Editor of the Times.

SIR: Arguments and expressions of opinion may be continued without end. Against those of Lord Kelvey and Dr. Stoney I will simply set some facts already stated, joined with one other.

1. Always mankind had the decimal system at their finger ends and used it for counting. In the course of civilization they departed from it in their systems of weights, measures, and values; gradually adopting instead sets of easy aliquot divisions, and especially duodecimal divisions.

2. For half a century after the metric system had been legally established the French did not discover its convenience. The alleged discovery of its convenience went along with the discovery that they would be punished if they did not use it.

3. In the United States, where the decimal division of money is used, it has been departed from in the center of most active business, the Stock Exchange, and a system of easy aliquot divisions employed in its place.

4. The additional fact not yet named is sufficiently striking. The ancient wise men of the East and the modern workingmen of the West have agreed upon the importance of great divisibility in numerical groups. The Chaldean priests, to whom we owe so much, doubtless swayed in part by their astronomical arrangements, adopted the sexagesimal system of numeration, which at the same time facilitates in a special manner the division into aliquot parts. For 60 may be divided by ten different numbers—2, 3, 4, 5, 6, 10, 12, 15, 20, 30. From this significant fact turn now to the fact presented in our ordinary foot rule. Each of its 12 inches is halved and rehalved, giving halves, quarters, and eighths. And then if we consider the subdivided foot as a whole, it gives us ten sets of aliquot parts. Beyond its 12ths the divisions yield $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{6}$, $\frac{1}{8}$ ($1\frac{1}{2}$ inch), $\frac{1}{16}$ ($\frac{3}{4}$ inch), $\frac{1}{24}$ ($\frac{1}{2}$ inch), $\frac{1}{32}$ ($\frac{3}{8}$ inch), and $\frac{1}{48}$ ($\frac{1}{4}$ inch). And this ordinary mode of dividing the foot rule results from the experience of centuries; for builders, carpenters, and mechanics, always buying foot rules which best serve their needs, have gradually established the most useful set of divisions. Yet now, though the early men of science and the modern men of practice are at one in recognizing the importance of great divisibility, it is proposed to establish a form of measure characterized by relative indivisibility. I am, etc.,

YOUR CORRESPONDENT.

April 30th.

We must say that the arguments adduced by Mr. Spencer appear to us of much weight. On the whole, it would seem more probable that an approximately perfect system of weights and measures should be evolved in the course of age-long practice, than that it spring fully developed from the brain of any *savant* or body of *savants*. Weighing and measuring make up and have always made up, in one form or another, a considerable portion of the business of every day; and men naturally take to those modes of measurement and calculation which offer the greatest facilities for the work to be done. Their minds have naturally moved in the lines of least resistance, and the methods sanctioned by the history of the race express this mental tendency. It is therefore greatly to be desired that no change may be made either in England or in this country looking to a disuse of old established and popular methods without a very thorough and earnest consideration of the effects likely to be produced on the life of the people. The *savants* can follow what methods they find most suitable for the very exact researches and determinations which they are called upon to make; but they should be very careful how they call upon the people to abandon methods and instruments which for everyday purposes answer all their needs, while affording aids to their mental operations which it is extremely doubtful whether the arbitrary system it is sought to introduce can ever supply.

AN ALLEGED CONSPIRACY OF SILENCE.

WE publish elsewhere a letter by Mr. L. G. Bostedo, Corresponding Secretary of the Chicago Single-Tax Club, commenting on a brief article published in these columns last month under the title of "Neces-

sity." The writer evidently thinks that to talk as we did of making "sound individuals" without postulating, as a necessary condition thereto, the general adoption of current theories in regard to the nationalization of the land, is useless. We are not, however, quite of his opinion on this point. We are not sure that there would be a larger proportion of sound individuals if the land were nationalized than there is at present. It is easy to say that an era of general prosperity and well-being would set in if these theories prevailed; but the thesis has never been proved, and the world is by no means persuaded that it is true. Fifteen years ago the doctrine excited much more interest than it does today, and was fervently believed in by many who now have either abandoned it altogether, or else have come to attach only a secondary importance to it. Mr. Bostedo believes that there is a "conspiracy of silence" on the subject in the press. If there is, we are not aware of it; we have certainly never joined the conspiracy. What seems to us to be the case is that the public has got tired of a question which was very widely discussed some years ago, but without any very satisfactory result. Our correspondent speaks of this journal as "conservative." We trust we are conservative in a right sense, and liberal in a right sense also. We believe that the principles on which human well-being mainly depends are very old; but we desire at the same time to see the latest results of human thought applied to the improvement of the general condition of mankind. The question whether land should be individually appropriated is manifestly one into which we can not enter to-day; moreover, it is not one which is likely to be settled to every one's satisfaction at any early date. Meantime we think it right to point out, as we did in the article under consideration, that character and general fitness for the work of the world have much, if not everything, to do with happiness and success in life. We all know "sound individuals" when we see them; and we know that they spring from almost every condition of life. A very sound individual, who had endured considerable hardships in his youth, became President of this nation some thirty-five years ago. We want more of that kind, and we should not wait to get the land laws fixed or unfixed before doing what may presently be in our power toward increasing their number through such agencies as education, free and temperate discussion, and righteous government.

One thing pleases us in Mr. Bostedo's letter, and that is his declaration that he does not, like very many of the advocates of the single tax, mix up with his arguments "a great deal of religious dogma and superstition and crude notions of natural rights, etc." Perhaps the large extent to which single-tax writers have resorted to just such faulty modes of reasoning in the past has something to do with the alleged "conspiracy of silence." That kind of thing has a very silencing effect on people who wish to keep their wits clear and their tempers sweet.

Scientific Literature.

SPECIAL BOOKS.

UNDER the able editorship of Sir Henry E. Roscoe the Century Science series continues to afford popular biographies of the leading European scientists of the nineteenth century, written by those who are to-day filling the places of their departed masters.* The life of Lyell was a steady and comfortable progress in knowledge and fame. He did not have congenital poverty or other serious obstacle to contend with, and his talents were high enough and his opportunities broad enough to insure his efforts a rich reward. The English universities had little of science to give in the second decade of the present century, so that Lyell's training in geology was picked up from outside sources in vacations and during his few years of not very arduous practice of the law. Prof. *Bonney* gives us a vivid sense of the paralyzing influence which was still exerted upon geology and all other branches of science in Lyell's early life by the supposed necessity for making all discoveries in the realm of Nature conform to the language of the Scriptures. Lyell was always in the van of the advanced thinkers in his chosen field, and apparently maintained this position without open rupture with the theologians. In describing his epoch-making work, the Principles of Geology, Prof. Bonney says, "It proved the writer to be not only a careful observer and a reasoner of exceptional inductive power, but also a man of general culture and a master of his mother tongue." Doubtless his literary ability joined with a happy endowment of tact enabled him to contribute greatly to the scientific revolution which culminated in Darwin, without being pilloried as Darwin was. Most of the events of Lyell's life are given in chronological order, but the author departs from this plan to give in one chapter a connected history of the eleven editions of the Principles that appeared in Lyell's lifetime. That he was a scientist of a high order is shown by the fact that he was able to change his opinion on an important question late in life, namely, the origin of species, when such evidence as Darwin presented was brought to bear upon it. This conduct caused Darwin to write, "Considering his age, his former views, and position in society, I think his action has been heroic"; and Prof. Bonney estimates as perhaps a greater service than any of his contributions to knowledge the constant readiness of Lyell to learn from others, and the manifestation of a judicial mind raised far above all partisanship and pride of opinion.

It needs but a glance at the finely cut features and long, high-vaulted cranium represented in the portrait of *James Clerk Maxwell* to show that his biographer has to record the life and labors of a genius. No one but a genius could have united Maxwell's mathematical penetration with his poetical ability, and the fact that his intellect was not well rounded on all sides is also characteristic of genius. His chief defects were a weakness in analysis and an inability to bring his teaching down to the level of the

* Charles Lyell and Modern Geology. By Prof. T. G. Bonney. Pp. 224, 12mo.—James Clerk Maxwell and Modern Physics. By R. T. Glazebrook, F. R. S. Pp. 224, 12mo. London: Cassell & Co., Ltd. New York: Macmillan & Co. Price, $1.25 each.

ordinary student. Mr. *Glazebrook* tells the story of Maxwell's life in a little less than the first half of the book before us, devoting the rest to an account of his works. The first part is enlivened by a sprinkling of characteristic incidents, while many extracts from his letters and addresses, together with a few of his verses, help to show the real nature of the man. His scientific work is grouped under three heads: Color perception, molecular physics, and electrical theories. He made researches experimentally as well as by mathematical processes, and a spinning top carrying various colored disks of paper became in his hands a most effective piece of apparatus. His later views on the molecular theory are to be found in the articles Atom and Diffusion in the Encyclopædia Britannica, but more important than his achievements in the two foregoing subjects were his theories as to electricity and magnetism. What these were our author tells with considerable fullness, giving some history of the subject before Maxwell, and quoting frequently from Maxwell's papers. A concluding chapter shows how discoveries made since his death, especially those of Hertz, have firmly established his views. Throughout the volume the effort has been constant to give readers with little knowledge of mathematics a realizing sense of the truths of physical science discovered by Maxwell, but it was impossible to avoid some details which only adepts will appreciate.

In the two parts of his recent book * Prof. *Zahm* has performed two services for Christians, especially Catholics, who are not quite clear as to what evolution is, and are concerned about the alleged conflict between this doctrine and religion. He first explains evolution with much fullness of detail and in an entirely nontechnical manner. He corrects at the outset the common error which restricts evolution to Darwinism, although he states that in this book he will deal especially with evolution in the organic kingdoms. He finds some rudiments of the theory in the speculations of the Greek philosophers, and traces its history down to the present time; he tells of the fanciful notions concerning fossils and gigantic bones found in the earth, which were held down to a recent period; he gives a sketch of the spontaneous generation controversy; and in two chapters he presents the evidences of evolution and the objections that have been urged against it. Then taking up the alleged conflict, which he everywhere treats as unreal, he ascribes many of the misunderstandings on this matter to misuse of terms, especially the terms "Creation" and "Nature," which he undertakes to define in accordance with Catholic theology. Classifying evolutionists as monists, agnostics, and theists, he discusses in succession their several standpoints as regards religion. In discussing monism he deals only with the utterances of Ernst Haeckel, whom he handles without gloves. He is more moderate with the exponents of agnosticism, although rating this view as worse than atheism, because the atheist will discuss the existence of God, while the agnostic denies that there are any data for such a discussion. He falls into the common error as to the source from which Huxley obtained the word agnostic, but gives in a footnote a quotation from a writer who evidently knew its real origin. He sees nothing

* Evolution and Dogma. By Rev. J. A. Zahm, C. S. C. Pp. 461, 12mo. Chicago: D. H. McBride & Co.

hostile to religion in theistic evolution, finding its germs even in the writings of St. Augustine and St. Thomas, while he shows that learned doctors of the Church have defined creation in a way which readily admits the operation of the evolutionary process. Taking up spontaneous generation again, he declares that belief in the possibility of this action—provided that force and matter be always regarded as under Divine guidance—is contrary to neither faith nor philosophy. It is allowable also to believe that man's body was derived from an ancestry of the lower animals, though his soul must be held as "in the case of each individual, directly and immediately created by God himself." Prof. Zahm expresses himself everywhere clearly, temperately, and in a readable manner. This is not his first publication on the relations of science and religion, but it is likely to be his last, as he has been called since it appeared to honorable duties at Rome, which probably will not leave him opportunity for further work in this field.

Although giving quite a full and coherent account of his scientific work, the *Life of Romanes** derives its chief value from the insight it gives into the private life and religious experiences of its subject. For a book written by his wife and completed just a year after his death this is entirely natural and commendable, and being thus largely a memorial tribute of affection it does not challenge the ordinary criticism of the reviewer. The first twenty-five years of Mr. Romanes's life are disposed of in eight pages. Then comes an account of his writing the essay which won the Burney Prize of 1873. The record of his life-work in biological investigations begins with researches on the nervous system of the *Medusæ*; and continues with his work on pangenesis, animal intelligence, physiological selection, inheritance of acquired characters, and various excursions on minor matters. The information given on these subjects is contained mainly in the correspondence which Romanes carried on with Charles Darwin, Francis Darwin, Thiselton-Dyer, E. B. Poulton, E. Schaefer, and others, for his wife has endeavored "to let him, especially in matters scientific, speak for himself." In this respect she is somewhat hampered by the fact that he "lived in almost daily intercourse for parts of many years with more than one of his most intimate friends. Hence there are no letters to several people with whom he was in the habit of discussing scientific, philosophic, and theological questions." There are also many letters relating to his personal affairs, his journeys for recreation or pleasure, and his diversions, of which music, writing poetry, and shooting were the chief. There is an evident solicitude on the part of Mrs. Romanes to show that her husband died in the Christian faith. Early in the volume she describes his period of agnosticism as an "eclipse of faith," and toward the end she devotes much space to his correspondence and his expressions of favorable views on religious matters. No attempt has been made to weigh the value of his contributions to science. The volume is illustrated with a frontispiece portrait and views of two houses in which Mr. Romanes resided.

* The Life and Letters of George John Romanes. Written and edited by his Wife. Pp. 350, 8vo. London, New York, and Bombay: Longmans, Green & Co. Price, $4.

GENERAL NOTICES.

The author's Fungi: their Nature, Influence, and Uses, which appeared in 1875 and passed through several editions, has long been the standard, and probably one of the best and most comprehensive works in our language on the subject. The rapid advance in knowledge of the life history and development of these organisms during the last ten years, and especially the large scheme of classification carried out by Prof. Saccardo, have, however, made it essential that, in order to keep pace with the times, a guide and introduction should be prepared for the use of students, which, without superseding the volume of 1875 as a popular instructor, should treat the subject more after the manner of a text-book, adapted to the illustration of recent discoveries, and an explanation of the methods of classification. The present work * is the result of an effort to supply this want. The first part of the book—organography—relates to the general character and features of the fungi. An attempt is made in the introduction to differentiate them from the other cryptogams, and particularly from the other thallophytes, the algæ and the lichens. Then the mycelium is described, and in the succeeding chapters the carpophore, or the supporter of the fructification; the receptacle, or envelope of the fructification where there is an envelope; the fructification, fertilization, dichocarpism, or the existence of two distinct forms of fructification; saprophytes and parasites, or fungi that grow on dead and those that grow on living organisms; and the constituents of fungi. The second part is devoted to classification, and begins with a chapter on fungi in general, after which the phycomycetes, the higher fungi, the meromycetes, and the mycomycetes, and their subdivisions—naked, spored, puffball, discoid, subterranean, capsular, gaping, conjugating, rust, mold, and slime fungi, and the rest—are described. The third part includes chapters on the Census of Fungi and their geographical distribution, and an appendix on collecting, to all of which are added a glossary and an index, together with bibliographies of each department.

* Introduction to the Study of Fungi. By M. C. Cooke. Pp. 360, 8vo. London: Adam and Charles Black; New York: Macmillan & Co. Price, $3.50.

The sixth edition of *M. Schützenberger's* standard work on *Fermentation* * is substantially a new book. It has been brought up abreast of the present condition of the science, which has made so great advances under the impulse given it by the discoveries of Pasteur. Nothing is required to be said of the importance of the theory of fermentations in science, and in its innumerable applications in the industries, agriculture, hygiene, and medicine. Many of the most important economical processes are dependent upon the action of ferments. In other processes the equally important thing is to prevent or stay it. In the first part of the book the author treats of the fermentations brought about by the intervention of an organized or figured ferment—alcoholic, viscous, lactic, ammoniacal, or butyric—and by oxidation; the second part is devoted to fermentations provoked by the soluble products elaborated by living organisms.

A series of *Chemical Experiments* has been prepared by *R. P. Williams*, author of two other chemical books (Ginn, 60 cents). The experiments are adapted for use with any text-book of chemistry, or without a text-book. They are especially designed to show the properties of substances and classes of substances, and more than half of the one hundred and two experiments—or, more properly, sets of experiments—deal with the reactions used in qualitative analysis. By means of a systematic and condensed mode of statement, directions for a great many operations are put into a moderate compass. The qualities that the author has especially aimed to give his manual are thus stated: "In preparing the experiments the author has endeavored, *first*, to select such as are most instructive and best illustrate the subject without being too elaborate;

* Les Fermentations (Fermentation). Par P. Schützenberger, Membre de l'Institut. Sixth edition. Pp. 315, 8vo. Paris: Félix Alcan.

second, to arrange them in an order calculated to lead up by the most natural and easiest steps to a knowledge of the science; *third*, to make the subject fascinating by giving just enough information and suggestion to interest the experimenter, and to make him work for the knowledge to be gained. Finally, the author has aimed to make the book simple enough for the dull and slow pupil, and, by the introduction of supplementary and original work, elaborate enough for the most acute." In the analytical part the reactions are given first for each metal of a group separately, thus showing why each reagent is added, and the whole group is then treated in the same way. The value of this method will doubtless be generally admitted. All the right-hand pages of the volume are left blank for notes or memoranda; there are lists of apparatus and chemicals required, directions for making solutions, suggestions for work and note-taking, and a plan of the laboratory of the Boston English High School, where the author is instructor in chemistry. There are thirty-nine cuts of apparatus.

The *Practical Inorganic Chemistry*, recently prepared by Dr. *G. S. Turpin*, of Swansea (Macmillan, 60 cents), is a small experimental manual for beginners, which opens with laboratory exercises that might be classed as either physics or chemistry, and after some drill on setting up apparatus proceeds through a series of simple chemical experiments, including three or four in which quantitative results are required, up to systematic qualitative analysis. The exercises run to one hundred and sixteen in number, and there are sixty-one figures of apparatus

The Subliminal Self (a part of our mind or faculty which apparently exists below the ordinary consciousness) is the chief subject considered in Part XXIX of the *Proceedings of the Incorporated Society for Psychical Research.* (Secretaries' offices, 19 Buckingham Street, Adelphi, W. C., London, and 5 Boylston Place, Boston, Mass.; 4*s.*) In preceding parts of the Proceedings, issued in 1891, 1892, and 1893, Mr. F. W. H. Myers has published seven chapters on this subject, and now in Chapters VIII and IX he continues the presentation and discussion of evidence bearing upon it. He states the general characteristic of the occurrences recorded as "to show us fragments of knowledge coming to us in obscure and often symbolical ways, and extending over a wider tract of time than any faculty known to us can be stretched to cover. On the one side there is *retrocognition*, or knowledge of the past, extending back beyond the reach of our ordinary memory; on the other side there is *precognition*, or knowledge of the future, extending onward beyond the scope of our ordinary inference." Instances of retrocognition differ from those usually classed as telepathy mainly in occurring after instead of at the time of the event. Those of precognition have been known before under the name of premonitions or warnings. A brief note in the same part states that a series of experiments tried by a committee with an Italian spiritualist medium had resulted in revealing nothing but systematic trickery. There is also a brief report of the Hypnotic Committee, a list of members, etc.

A bulletin of much practical value, on *Timber*, prepared by *Filibert Roth*, has been issued by the United States Department of Agriculture. It gives the structure and appearance of hard and soft woods, and describes their mechanical properties and the methods employed for testing them. Other characteristics dealt with in less space are weight, moisture, shrinkage in seasoning, chemical properties, durability, and decay. Directions for distinguishing the different kinds of wood are given, and there are an analytical key to the more important woods of North America and an alphabetical descriptive list of the same. The pamphlet is fully illustrated.

The *Manual of Phonography* prepared by *Norman P. Heffley* (American Book Company, $1.25) is designed especially for class use, but may be used for self-instruction. It is based on the ninth edition of Isaac Pitman's Phonography, but embodies many improvements in teaching that have been made in recent years. The book is thus described by the author: "The 'corrresponding' and 'reporting' styles have been blended into a natural and orderly method, each principle when introduced being thoroughly explained and its application illustrated by ample practice in reading and writing. . . . The num-

ber of arbitrary word signs has been reduced to a minimum consistent with requirements for all purposes, and the entire system has been rearranged into a series of easy and progressive lessons. . . . It contains a complete exposition of all the principles, word signs, and contractions that are requisite for the most difficult reporting purposes."

In the bulletin on *Farmers' Institutes* in 1894–'95, issued by the Michigan State Agricultural College, there are reported nine institutes—abstracts of the papers read, and brief summaries of the discussions held at each, being given. These reports have a liveliness and meatiness that mark the meetings as occasions of much profit.

Whittaker, in London, and Macmillan, in New York, publish *The Chemist's Compendium*, compiled by *C. J. S. Thompson* (price, $1). It is a handbook of information for druggists, containing the formulas of the British Pharmacopœia given briefly and arranged alphabetically, a posological table, the unofficial formulary of the British Pharmaceutical Conference, some directions for dispensing French and German prescriptions, besides many lists and tables relating to analysis, poisons, photographic chemicals, freezing mixtures, doses for domestic animals, artificial fruit essences, solubilities, etc., etc.

Volume XXXIV of the Annals of the Harvard Observatory is devoted to a *Catalogue of 7,922 Southern Stars*, by *Solon I. Bailey*. These observations were made from the top of Mount Harvard, near Lima, Peru, and are intended to furnish magnitudes for the southern stars on the same scale as that on which the magnitudes of the northern stars are expressed in Volumes XIV and XXIV. Two chapters describing respectively the plan and the reduction of the observations are prefixed, and another, giving a history of the expedition, in which the obstacles encountered are described and information as to the suitability of a number of sites for astronomical work is given. Part IV of Volume XL and Part III of Volume XLI of the Annals are devoted to meteorology. The former is a report on the *Observations made at the Blue Hill Meteorological Observatory in 1894*, under the direction of *A. Lawrence Rotch*. An appendix to the tables gives the results of a series of comparisons of anemometers begun in 1892. The latter of these publications embodies the *Observations of the New England Weather Service*, which has one hundred and ninety-two volunteer observers, with *J. Warren Smith* as director. Accompanying the tabulated observations and based upon them are a description of the weather month by month, a list of severe storms, and a map showing the mean annual isotherms in New England for 1894.

Terrestrial Magnetism is a quarterly journal which has been added to the list of periodical publications of the University of Chicago. It is edited by Dr. *L. A. Bauer* and a corps of associates representing most of the countries of Europe, the United States, China, Java, and Australia, the intention being to give it an international character. All languages that can be printed with Roman characters will be admitted to its pages. The chief contributions to the first number (January, 1896) are: On Electric Currents induced by Rotating Magnets, and their Application to Some Phenomena of Terrestrial Magnetism, by Arthur Schuster, F. R. S.; and Die Vertheilung des erdmagnetischen Potentials in Bezug auf beliebige Durchmesser der Erde, by Dr. Ad. Schmidt. This number contains also a photographic reproduction of Halley's earliest equal variation chart, with a brief history by the editor. (University of Chicago press, $2 a year.)

The Bachelor and the Chafing Dish is the title of a little book for the gourmet, by *Deshler Welch*. The work consists of a number of "informal" receipts for preparations which can be cooked in a chafing dish. There is considerable somewhat amusing and desultory talk interlarded, most of the receipts being given after the description of an appropriate situation, such as a camp in the woods or at a sick friend's bedside. There is appended a glossary of the various terms used in cooking. (F. Tennyson Neeley, Chicago.)

On account of its covering part of the year of the Columbian Exposition, the *Report of the Commissioner of Education for 1892–'93* contains an unusually wide range of interesting matter. The Exposition material includes essays on the educational

exhibit, as a whole, by various American writers; many accounts of American education by foreign visitors; notes on the exhibits of separate States and foreign countries; and a series of papers prepared for the World's Library Congress, which together constitute a treatise on library economy. Among the subjects presented in other parts of the report are American Educational History; the Report of the Committee of Ten on Secondary School Studies, with papers relating thereto; Pecuniary Aid for Students; the Education of the Negro; and Medical Education. The usual statistics are presented. Those of the common schools show an increase of 1·92 per cent in enrollment and 3·45 per cent in average attendance over the preceding year.

Number 1 of Volume III of The Transit, a magazine published by the Engineering Society of the State University of Iowa, is entirely taken up by a monograph on *Portland Cement*, from the pen of *Charles D. Jameson*, Professor of Engineering at the university. A general consideration of the properties of lime and cement is followed by some historical data regarding the early use of cement both here and abroad, a general review of the methods of manufacture and testing, and the chemical processes concerned in the hardening of hydraulic cements. A number of good pictures show the various pieces of apparatus employed in its manufacture, and several structures in which the so-called monolithic, or artificial stone construction, has been used.

The last publication in the New Brunswick school series to reach us is a little *Teachers' Manual of Nature Lessons*, by *John Brittain.* It aims only, the author says, to be a useful index to some of the elementary chapters of the book of Nature, and to indicate briefly the means by which children may be led to read them with pleasure and profit. The text consists of suggestions for talks and simple experiments illustrating some of the more elementary facts of geology, chemistry, physics, and natural history. (J. & A. McMillan, St. John, N. B.)

A historical and descriptive sketch of *The Yellowstone National Park*, by *H. M. Chittendon*, has recently come to hand. It deals first and principally with the history of the upper Yellowstone, from the days of the early explorers to the present time. The descriptive portion of the work contains a fairly comprehensive treatment of the natural features of the park. Some good maps and a number of well-chosen pictures, the latter of which are somewhat marred by poor paper and printing, add value to the book. A few illustrated biographical sketches of the early explorers and a bibliography of the literature pertaining to the region are appended.

Much of the time expended in computations is wasted through the use of an excessive number of places of figures, and through failure to employ logarithm tables. The use of logarithms for work of four or more places, not only effects an important saving of time over direct multiplication or division, but also conduces to greater accuracy. *Computation Rules and Logarithms*, by *S. W. Holman*, consists of a number of simple rules indicating the number of places to be used in a given computation; "an explanation of the use of the notation by powers of ten; certain instructions, more or less novel in form, as to the use of the logarithm and other tables; and a collection of useful tables." The book is well bound and printed. (Macmillan, $1.)

The Molecular Theory of Matter, which has seldom been given more space outside of Germany than a chapter or two in a general work on physics, now has a volume, by *A. D. Risteen*, devoted to it (Ginn, $2). After giving some general considerations, the author divides his subject into the kinetic theory of gases, of liquids, and of solids, molecular magnitudes, and the constitution of molecules. He aims only to present the accepted views on these topics in a form that can be readily grasped by students, and where competent physicists disagree he lets the fact be known. There are frequent references to original sources, and some fifty diagrams and other figures are used.

The Eclectic School Readings is a series of books to supplement the usual school reading books. Two have come to us, *Stories of Great Americans for Little Americans*, designed for the usual second-reader grade, and *Stories of American Life and Adventure*, for the third-reader grade (American

Book Company, 40 cents and 50 cents). Both are by *Edward Eggleston*, who has aimed to lighten the labor of learning to read by presenting stories containing enough spirit and movement to interest the young. He has also seized the opportunity to implant a love of America in the American child by drawing his subjects from what might be called the heroic age of the United States. We are glad to see such a master hand in writing "true stories" enlisted in the service of the young. The only improvement we could suggest would be to combine a love of Nature with a love of country. A combination of Eggleston and Burroughs, for example, would yield a product well-nigh perfect.

The *Eighth Biennial Report of the Bureau of Labor Statistics of Illinois* is devoted to taxation, and it shows how large property owners, especially in the chief city of the State, throw an unfair portion of the burden of taxation upon their poorer neighbors. This is accomplished by undervaluations often grotesquely small, and by assessing vacant land lower than land of equal value bearing improvements. While Chicago real estate receives most attention, considerable information concerning the property of railroad and other corporations in the State is presented. The Bureau recommends that State taxes be levied solely on site values of land, and advocates several changes in administration. An appendix contains information concerning the coal-miners' strike in 1894, and the decision of the State Supreme Court on the Sweat-shop Act. A compilation of the Labor Laws of the State of Illinois is included in the same volume.

In *Statesman and Demagog*, a pamphlet by *Alphonse Allman*, of San Francisco, a dynamical theory of money is presented, with many mechanical analogies and diagrams. Unfortunately, his analogies seem to run away with him in places, and in making his theory plain to those versed in mechanical principles he has obscured it from every one else.

In *Bilder aus der deutschen Litteratur* the student is given a bird's-eye view of the field, with many favorite ballads, some extracts from longer pieces, and the outlines of the chief prose works, but without too many dates and statistics. The author, Prof. *I. Keller*, of the Normal College, New York, has aimed to use language which the student can read at sight (American Book Company, 75 cents).

The Secret of Mankind (Putnams, $2) belongs to a class of books to which the name Utopian might be given, as it presents the (anonymous) author's ideal of human society in the form of a description of an imaginary state. Another favorite form of writing with a certain class of writers—conversations with the shades of the departed great—is also used. Metaphysics, ethics, government, and education are the chief topics discussed.

Under the title *Light on Current Topics* (Massachusetts New Church Union, Boston, $1) a series of lectures setting forth the teaching of the Swedenborgian Church on certain topics of present interest has been issued in book form. Among the subjects treated by various lecturers are, Theosophy and Religion, The Relation of the Church to the State and to Secular Affairs, and Pauperism and Crime.

The Interstate Commerce Commission has issued its seventh annual volume of *Statistics of Railways in the United States*, giving information about mileage, capital, earnings and other income, expenditures, and charges against income on account of capital covering the year ending with June, 1894. The year was exceptional in several ways. It included the last four months of the Columbian Exposition, which had an important influence on the passenger traffic, and it covered a part of the period of the recent business depression. The latter fact is apparent in all the tables, and especially in the unequaled percentage of the mileage of the country in the hands of receivers.

In its *Report on Coal in Illinois* for 1894, the Board of Commissioners of Labor of that State has presented statistics on the output of mines, value of the coal, cost of mining, number of employees, days of active operation, wages, the use of powder, casualties, and the ventilation of mines. This information is arranged both according to districts as reported by the several State inspectors of mines and in summary form. An appendix contains statistics of the coal-miners' strike of 1894 and of the world's production of

coal, the latter reprinted from a report by Robert Giffen to the British House of Commons.

The *Report of the United States Commission to the Columbian Historical Exposition at Madrid* comprises a brief account of the participation of the United States in the Exposition, by Rear-Admiral Luce, who was the commissioner-general for this country; a report by Dr. Daniel G. Brinton on the collections exhibited; catalogues of the anthropological, numismatic, historical, and other objects sent by various institutions and government departments of the United States; and descriptive essays on several classes of these objects. Mr. William E. Curtis furnishes a report on the historical part of the exhibit, which included seventy-seven portraits of Columbus, only one of which was made during his life, and a considerable number of pictures representing places identified with the life history of Columbus, or the remains of Spanish occupation in the United States, or subjects connected with the origin of the name America. Many of the portraits are reproduced, and other parts of the volume are fully illustrated.

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Fragments of Science.

Mysterious Fractures in Steel.—The so-called mysterious fractures in steel, with which every engineer is familiar, bid fair to become things of the past. The following facts, taken from a recently reported analysis of specimens from a fractured steamship "tail shaft," are especially interesting, as showing the great value of investigations which at first sight may seem entirely barren of anything but theoretical interest. This accident, which a few years ago would have been put down as one of those "mysterious breaks," probably due to "fatigue," the shaft having been in practically continuous use for twelve or fourteen years, was fully explained by the subsequent examination. A

chemical analysis was first made which indicated that the ingot from which the shaft had been forged was cast too hot; that the carbon was very unevenly distributed, the center of the shaft containing fifty per cent more than the portion near the circumference; and, finally, that the content of sulphur and phosphorus was three times greater in the core than at the circumference, and excessive in all parts of the mass. But the most important and instructive results were obtained in the microscopic examination of sections. Micrometallography is a comparatively new science, which, however, already promises to be of great practical value to the metal-worker. The microscopical examination showed a bad structural arrangement of the iron and steel "cells," especially in the core. The phosphorus, as phosphide, was distributed pretty generally, and the cohesion between crystals rich in phosphide is very faulty. The center of the shaft was riddled with sulphide of iron, and was little tougher than good gray pig iron. "It is almost certain that a number of sulphide flaws of the interior gradually worked outward, along the crystalline junctions of the fairly tough metal outside, until under a vibratory shock of unusual force the whole mass ruptured."

The Tsetse Fly.—The few travelers whose lot has led them through the lowlands of equatorial Africa have most of them reported the tsetse fly (*Glossina sp.*) as one of the most formidable impediments in the way of colonization or even exploration of these regions. Wild animals and human beings suffer only temporary irritation from its attacks, but domestic animals entering the fly districts are seized in the course of a few days with fever and wasting, and almost invariably die. The tsetse is a dipter, having a pale yellow abdomen and gray, striped thorax. It is rather larger than the house fly. The mouth parts form a powerful piercing beak. From an account of a report on the tsetse-fly disease, by Surgeon-Major David Bruce, published in Nature, we learn that there has at last been an attempt made to study the fly and its disease in a thorough and scientific manner. As far back as 1870 a Mr. St. Vincent Erskine endeavored to show that the disease was due solely to change of grass and climate. Since then several other travelers have stated their belief that the fly was not injurious, or, at any rate, that the ill effects of its bite were much exaggerated. At last the Natal Government has authorized Mr. Bruce to thoroughly investigate the tsetse-fly disease, and his paper is the outcome of the first three months' work. The results so far attained seem to indicate not the action of a specific virus, as was originally supposed, but the transmission by the tsetse fly of a bacterium or its products. The investigation is proceeding along somewhat the same lines which Dr. P. Manson is following in endeavoring to trace the malaria plasmodium through the mosquito. A similar relationship was traced some years ago between Texas fever, a disease of cattle, in which certain parasitic bodies were found in the red blood corpuscles, and the cattle ticks (*Ixodidæ*). Among the new facts brought to light by Dr. Bruce's work, one of considerable importance is the specific action which arsenic seems to have on the disease; its administration causes a reduction in temperature, a maintenance of the normal number of red blood cells, and a disappearance of the hæmatozoa from the blood.

Serum Therapy and Blood Brotherhood.—The very ancient practice of the transfusion of blood from one person to another, as a means of cementing friendship, seems, in the light of the modern serum treatment of disease, to have been something more than a purely sentimental operation. In a recent letter to Nature, T. L. Patterson discusses the probable value of such inoculations. He thinks it very probable that a European inoculated with the blood or serum of a native would be better able to resist the climatic changes to which he is subjected in tropical countries. "In other words, would blood inoculation not set up in his system those changes necessary to adapt him to the climate, and render him immune to the diseases which are the result of the climate? The suggestion is based on the assumption that the native is more healthy in his own climate than any foreigner can be, and that blood inoculation would acclimatize the latter at once. The advantages to be derived from such a system are obvious. At present, in central Africa, many missionaries and pioneers are annually sacrificed to the cli-

mate." Blood brotherhood is still extensively practiced among savages, and is common in central Africa; the essential part of the process consists of making an incision just sufficient to draw blood in the right wrist of each of the participants. A little of the blood is scraped off of each cut and smeared on the other's cut. It seems quite probable that a further study of this practice may reveal a prophylactic measure of great practical value.

A New Old Skull.—Prof. A. Nehring has recently described a new human skull of low type found near Santos, in Brazil, of which an account is given by A. C. Haddon in Nature. It was found in a breccia, the exact age of which is uncertain, associated with fish vertebræ, a few fragments of other human remains, and a portion of the lower jaw of a toothed whale. The forehead is low and retreating, the glabella and orbital ridges well developed. The frontal ridge is greatly constricted behind the orbital region, as in *Pithecanthropus.* The principal measurements given are: Maximum length, 183 mm.; maximum breadth, 135 mm.; minimum frontal, 88 mm.; maximum frontal, 92 mm.; frontal sagittal arc, 118 mm.; and the parietal arc, 134 mm. The face of this cranium was strongly prognathous, the whole dentition is strong, and all the teeth are perfectly sound. The dimensions of the premolars and the molars come very close to those of Spy No. 1 skull, any difference there may be being in the direction of the dentition of Spy No. 2. While the length and breadth of the new skull agree fairly closely with those of *Pithecanthropus*, the cranial height is considerably greater, and consequently also the cranial capacity.

Animal Intelligence.—Evidence of the almost human abilities of some of the higher apes is no new thing, but a new series of observations are called attention to in a recent Spectator. The account is taken from A. E. Brehm's book, From North Pole to Equator. "The baboons were on flat ground, crossing a valley, when the traveler's dogs, Arab greyhounds, accustomed to fight successfully with hyenas and other beasts of prey, rushed toward the baboons. Only the females took to flight; the males, on the contrary, turned to face the dogs, growled, beat the ground with their hands, opened their mouths wide and showed their glittering teeth, and looked at their adversaries so furiously and maliciously that the hounds, usually bold and battle-hardened, shrank back. By the time the dogs had been encouraged to renew their attack the whole herd had escaped to the rocks except a six-months-old monkey. The little monkey sat on a rock surrounded by the dogs, but was rescued by an old baboon, who stepped down from the cliff near, advanced toward the dogs, kept them in check by gestures and menacing sounds, picked up the baby monkey, and carried it to the cliff, where the dense crowd of monkeys shouting their battle cry were watching his heroism. The march of the baboons is not a mere expedition of the predatory members of the community. The whole nation *trek* together and make war on the cultivated ground in common. No wild animals have developed their powers of combined attack and defense in so creditable a manner as the baboons. Their motives—defense, not defiance—are irreproachable, and their methods deliberate, self-reliant, and effective, and Brehm justly remarks that there is probably no other male animal which runs into danger voluntarily to rescue a young one of its own species."

Individual Communion Cups.—A gratifying indication of the broadening influence which science is so slowly, but none the less surely, perhaps, exerting among the people at large is contained in the following paragraph clipped from a morning paper, Jersey City, N. J., April 5th: "Individual communion cups were used for the first time in the First Presbyterian Church on Emory Street, this morning. There were six hundred communicants present, each having a new cup. The cup used is glass, with a light gold rim, and is not costly. They were passed around on trays that held thirty-six glasses each. After using, the glasses were placed in the hymn-book racks and were collected by the sexton after the service. The Rev. Dr. Charles Herr, the pastor, said he thought the individual cups had come to stay." As we learn more and more of the means by which disease is propagated, it should be the endeavor of all to aid in the

use of this knowledge in devising new methods or modifying old ones for the prevention of communicable disease, and the extension of it from person to person. In many maladies the secretions of the mouth become highly infected, and are a source of the most immediate danger to any one coming in contact with them. Dr. E. A. Wallace, in writing on this subject, says: "At a recent meeting of the Monroe County Medical Society, in New York, an epidemic of diphtheria was reported by one of the health officers. This epidemic was confined to a single school district, twenty-four families being afflicted. The contagion was traced back to the drinking cup used in school by the diphtheritic children. Microscopic examination revealed the diphtheritic microbes adhering in great quantities to its rim." Dr. Alfred Ashmead says: "The last time I knelt at the communion altar there knelt at one side of me a patient whom I knew (as I was treating him at the time) to be suffering from an odious disease; his mouth contained patches which made it especially contagious. This person took the cup before it came to me; of course I let it pass." (But what of the communicants beyond the doctor who did not know!) In fact, there can be no reasonable doubt that many cases of infectious disease have been and are still caused by the communion cup, and when one considers what some of them are, how horrible the contraction of such a disease is by any one, and how especially pitiful in the case of a young girl, it is hard to be patient with the stupid superstition which upholds the continuance of such a custom. There are so many paths by which infection may reach us, and over which we have, as yet, no control, that the few cases in which we have some power should be made the most of.

Short Method for Producing Antitoxine.—An interesting paper, by Dr. G. E. Cartwright, was recently read before the Royal Society on A Method for Rapidly Producing Diphtheria Antitoxines. Two species of diphtheria toxine were made use of—the ordinary toxine produced by the organism in peptone broth, and secondly the substances present in serum-broth cultivations which had been filtered and heated up to 65° C. As a rule, the broth was inoculated with a virulent diphtheria culture some three or four days previous to the addition of the serum, and then incubated at a temperature of 37° C. for at least three or four weeks. Before being used for injection it was subjected to a temperature of 65° C. for about an hour, and then filtered through a sterilized Chamberland candle to remove the bodies of the bacilli. This fluid the author calls "serum" toxine, in contradistinction to the ordinary poison, "broth" toxine. The serum toxine gives rise to little local irritation, but to marked febrile reaction. In addition it was found that animals which had been subjected to its action were rendered more or less refractory to subsequent infection, and this suggested the possibility of its application as a means of shortening the preliminary treatment which a horse must undergo before it can receive the large doses of broth toxine which are usually necessary for the production of antitoxine of any strength. A horse was treated as follows: He received during the first twelve days three hundred and eighty cubic centimetres of serum toxine spread over three injections on different dates. On the nineteenth day fifty cubic centimetres of unfiltered serum toxine (sterilized at 65° C.) and one hundred and fifty cubic centimetres of broth toxine (of which half a cubic centimetre killed a five-hundred-gramme guinea-pig in forty-eight hours) were injected. The experiment was somewhat impeded at this point by the formation of a small abscess, which was subsequently avoided by filtering out the bodies of the bacilli. On the twenty-eighth day fifty cubic centimetres of the same broth toxine were injected, and on the thirtieth day another injection of one hundred and fifteen cubic centimetres was given. The horse was bled on the thirty-second day of treatment, and the serum was found to possess the strength of ten normal units (one one-hundredth cubic centimetre protected a two-hundred-and-fifty-gramme guinea-pig against ten lethal doses of broth toxine). "As this strength is only attained by Roux's method after at least ten weeks' treatment, it was evident that the serum treatment had considerably shortened the process." The horse was then subjected to the ordinary method for producing antitoxine, when it reacted in every respect like an animal which had been under the usual treat-

ment for several months. In the next horse much larger quantities of the serum toxine were used, with the addition of a certain amount of antitoxine, to avoid the risk of constitutionally injuring the animal. The horse was bled on the thirtieth day, and the antitoxic value of its serum tested. It was found that one one-thousandth cubic centimetre protected completely against ten lethal doses of the toxine; and finally, after nine weeks' treatment, one twenty-five hundredth cubic centimetre protected against ten lethal doses.

Japanese Rice.—Rice is the most important of all Japanese crops; the cultivation takes up more than half of the total surface of arable land. The report of the Chevalier de Warpenarst, Belgian vice-consul at Yokohama, is authority for the following details, which we find in the Journal of the Society of Arts. Japan produces two kinds of rice, viz., rice of the lowlands, which is watered by an ingenious system of irrigation, and the rice of the mountains. The latter requires very little water and sun, while it is impossible to have too much for the former. Lowland rice is subdivided into two kinds—ordinary rice and glutinous rice, the latter forming about eight per cent of the annual crop. The ordinary rice is of three varieties—early, medium, and late. The total rice crop of 1892 was 41,379,000 *koku*, which is equivalent to 205,360,000 bushels. About the end of May the winter crop is gathered in, and some time between the end of September and the end of October the summer crop is ready for harvesting. About 34,000,000 *koku* of the annual production are for home consumption. It is the upper and middle classes who eat rice, the poor being seldom able to obtain it, their food consisting of the leavings of the rich—stale fish and fish entrails, which are cooked all together and sold about the streets on stalls. The farmer himself eats barley, corn, millet, and the sweet potato, but rice only on *fête* days. Besides the 34,000,000 *koku* used for food, there are about 500,000 *koku* used for brewing purposes, and 3,000,000 more in the manufacture of the drink known as *saké*.

Science as a Help to Agriculture.—Much was made of the work of the United States Department of Agriculture in the discussion in the British Association of the question, "How shall agriculture best obtain the help of science?" In the course of the discussion Prof. Marshall Ward said that it was of extreme importance that the results of any investigations should be made known at once and accurately to the practical man, and this was work that might very well be undertaken by the Government; but he deprecated any direction or control from a Government department in any matters of original research. There was at present in existence a large mass of information as to agriculture and forestry which had never yet been made available for the practical man. Criticising some of the methods of agricultural teaching as at present carried out, Prof. J. R. Green said that the farmer was apt to regard chemistry as comprising only the chemistry of soils, whereas it was of even greater importance to pay attention to the chemistry of plants, and generally to give the plant organism the same attention from various points of view that was now given as a matter of course to the animal organism. Prof. Perceval, of Wye College, also emphasized the importance of paying attention to the chemistry of the plant and not of the soil only. Lectures on scientific agriculture were successful if the elements only of the science were explained in non-technical language, and the farmers were then taught to make experiments for themselves. Mr. M. J. B. Dunstan thought much of the prejudice against science arose from the mistaken idea that it was meant to replace experience instead of supplementing it.

Marriage Customs of the Shans.—Marriage celebrations among the Shans are rather unpretentious affairs. The ceremony varies from the simple arrangement of taking each other's word for it to feasts lasting several days among wealthy people; but even in these cases the actual ceremony is a minor feature in the proceedings. The usual form among western Shans is for the couple to eat rice together out of the same dish in the presence of their relatives and the village elders. The bridegroom then declares that he marries the lady and will support her. More ceremony is observed among the Lü. The hands of bride and

bridegroom are tied together with a piece of string after they have eaten together, and an old man pronounces them duly married. The Hköns throw rice balls at each other and the couple during the ceremony. The newly married couple then go to their house, and split betelnuts are distributed among the relatives of the bride, who give money as a return present. Divorce is readily obtainable, but, except among young people of low rank, is comparatively rare. A man can have more than one wife if he can afford it. In case of divorce the property is divided according to the laws of Menu; and the applicant for the divorce, when the desire is not mutual, or the person through whose fault the divorce is applied for, always loses considerably in the division.

Psychology of Puppies.—A publication on the Psychic Development of Young Animals and its Physical Correlation, by Wesley Mills, embodies the results of the study of a litter of thirteen St. Bernard puppies—ultimately reduced to six—from birth to sixty days of age. The facts most striking in the first few days of life were the frequent desire to suck, the perfect ability to reach the teats of the dam just after birth, the misery evident under cold and hunger, and the fact that the greater part of existence is passed in sleep. Nothing is more striking than the efforts the animal makes almost as soon as it is born to place itself in a surrounding of comfort. Sucking is improved by practice, and is subject to modification with the increasing experience of the animal. The effects of stroking, smoothing movements of the hand are very striking. The temperature sense appears to be well marked from the first, and the muscular sense early present and finally well developed. Even on the day of birth the puppies would not creep off from a surface on which they were at rest if it was elevated a short distance from the ground. Taste and smell are very feeble at first, and are gradually developed. The "opening of the eyes" is a very slow process. It began in the St. Bernards on the eleventh day; but it is doubtful if the animal sees at all, in the proper sense of the word, till the lids are completely separated, if even then. The indications concerning hearing are indefinite and obscure; but the puppies were very early stimulated by concussions. No attempts were made to play while the eyes continued closed; but when play began, the observation of its development was very interesting. On the twenty-sixth and thirty-third days the sense of fun or humor seemed to be shown. The puppies were very readily susceptible to fatigue, in view of which the sleep they indulge in so greatly is seen to be very necessary to them. The first evidence of will, as marked in motions other than those described as reflex, was observed on the seventeenth day. The tail was not wagged while the eyes were unopened. Puppies usually cry like a kitten. Gradually this voice is changed to that characteristic of a dog. Before barking in any form, growling in sleep, and then in play, is observed. Prof. Mills finds two great periods of development in the puppy—one before the eyes are opened, and the other afterward. Development is slow in the first period and existence almost vegetative; an intermediate period is marked by considerable advance, though slow as compared with the progress made in the next few days. The period between the seventeenth and forty-fifth days is the one of the greatest importance; and after that a constant improvement from experience goes on till the sixtieth day. These periods, however, are not distinct, but glide into one another.

The Discoverer of Robinson Crusoe.—In a recent address before the Historical Club of the Johns Hopkins Hospital Dr. William Osler related the curious history of Thomas Dover, of Dover's powder fame, whose contribution to therapeutics seems to have constituted the least of his claims upon posterity. Of the facts of Dover's life little was known. Munk states that he was born in Warwickshire about 1660. He was a Bachelor of Medicine of Cambridge. After taking his degree he settled in Bristol, and having made money joined with some merchants in a privateering expedition. Little is known of his life up to this time. He was associated in this undertaking with a group of Bristol merchants. The expedition went in two ships, and Dover was third in command. The days of the buccaneers were almost numbered, but there was in Bristol at this time one of the last

and one of the most famous of the old South Sea captains, William Dampier, a man who knew more of the Spanish Main and of the Pacific than any one living. He was engaged to accompany the expedition as pilot. They started in 1708, and the voyage lasted three years. In February, 1709, while lying off the island of Juan Fernandez, they observed a light on the shore, and several days later, after the abatement of a storm, which prevented their earlier landing, they went on shore, where they found the original of Defoe's Robinson Crusoe. He was clothed in goat skins, and "seemed wilder than the original owners of his apparel." His name was Alexander Selkirk, a Scotchman, who had lived alone on the island for four years and four months. Captain Thomas Dover returned from the South Seas in 1711, a wealthy man; his subsequent career is only imperfectly known. In 1721, however, he was admitted licentiate of the Royal College of Physicians, a qualification which enabled a man at that time to practice in and six miles around Westminster. In 1732 he published a work entitled The Ancient Physician's Legacy to his Country, in which, he says on the title-page "the extraordinary effects of mercury are more particularly considered." On page 18 is given the formula of his famous powder: "Take opium one ounce, saltpetre and tartar vitriolated each four ounces, ipecacuanha one ounce. Put the saltpetre and tartar in a red-hot mortar, stirring them with a spoon until they have done flaming. Then powder them very fine; after that slice in your opium, grind them to a powder, and then mix the other powders with these. Dose, from forty to sixty or seventy grains in a glass of white wine posset, going to bed, covering up warm, and drinking a quart or three pints of the posset. Drink while sweating." He says that some apothecaries have desired their patients to make their wills and settle their affairs before they venture upon so large a dose as sixty or seventy grains. "As monstrous as they may represent this, I can produce undeniable proofs where a patient of mine has taken no less a quantity than a hundred grains and yet has appeared abroad the next day." Dover continued to practice in London, and in the seventh edition of The Ancient Physician's Legacy there is a letter to him from Catherine Hood, in which she speaks of having consulted him in 1737. He is stated by Munk to have died in 1741 or 1742.

Sisal in the Bahamas.—Sisal fiber which is next in importance to hemp in rope-making, derived its commercial name from the port of Sisal, from which it was originally shipped in the Bahamas. In Yucatan the plant is called *henequen*. *Agave sisalana*, which is its botanical name, had its original home in Mexico; it belongs to the same family as the well-known century plant. On account of its value as a fiber-producer it has now been widely distributed in tropical and subtropical countries. It does not require a rich soil, and can get along with surprisingly little water. The plant is best propagated by means of suckers, which it produces abundantly; they are allowed to reach sixteen or twenty inches in height and are then "lifted" and the roots trimmed and some of the lower leaves removed before resetting. Leaves fit for cutting are produced in three or four years. During the first season of yielding, however, only a few of the larger leaves are removed; subsequently ten or fifteen leaves are cut from each plant. The cutting is done from one to three times a year. The leaves are cleaned by a machine which turns out from one half to one ton of fiber a day; the cleaning should be done within a few hours after the leaves are harvested, as the fermentation which soon starts up in the saccharine matters surrounding the fiber very soon discolors and seriously weakens it. When cleaned before fermentation has set in, the fiber is perfectly white; after passing through the machine it is hung out in the sun to dry, and when dry tied up into bales of three hundred and fifty to four hundred pounds each. An acre of land with six hundred and fifty plants will yield from twelve hundred to fifteen hundred pounds of fiber per annum, the price of which has varied from £50 per ton in 1889 to £13 in 1895. In March, 1896, it was quoted at £17. A plantation lasts about fifteen years, if carefully cared for. It is necessary, however, to be continually replacing individuals that have "poled." This is the supreme effort in the life of many plants of the agave tribe, and with it they complete their life history.

The flowering panicle or pole is a huge inflorescence sent up from the heart of the plant. It is fifteen to twenty feet high, and sometimes higher. From the base, which is about four inches in diameter, it gradually tapers upward into a fine, slender rod. The branches carry numerous greenish-yellow flowers, giving the whole a candelabral character. In *Agave sisalana* the flowers are seldom followed by seed pods; exceptionally, one or two may be produced. When the flowers have fallen off, at the ends of the branches in the axils near the flower scar there are produced numerous small bulbels, which eventually develop into plantlets of considerable size. These are locally called "pole plants," and the sisal plant is capable of being abundantly propagated, either by means of the "pole plants" or "root suckers," the latter of which, however, are preferred by the planters.

The Toba Lake.—The most striking feature of the Batak tableland of Sumatra is the great sheet of water known as the Toba Lake, of which, though only as a name, geographers have been cognizant for more than a century. It lies, according to Baron Anatole von Hugel, about twenty-five hundred feet above the sea; and, trending from the southwest to the northeast, has a length of about fifty miles, with an average breadth of sixteen miles. It is oblong in shape, and has a considerably indented coast line. The natives call it by two distinct names; for the central third of its length is so blocked by a large and populous island as to divide it into two basins. The island consists of a compact mountain range of gentle contour, attaining its greatest height at fifty-two hundred feet. Of the narrow channels which separate this island from the mainland, one is navigable at all times, while the other is so shallow as to be fordable on foot when the water is low. The lake has a considerable outflow, which, after a short course, forms a respectable waterfall, and eventually joins the sea. No river, however, flows into the lake; and the insignificant rivulets and brooks that run down its steep shores are the only visible streams that feed its wide waters—a large expanse, indeed, considering that its water-surface area is three times that of the Lake of Constance. The frequent and regular changes in the hue of the lake are a peculiarity worth mentioning. "Of a morning, the surface being then mostly unruffled, it appears of a fine dark blue, which changes to a greenish tint along the shores; by noon it is of a leaden gray; and of an afternoon it is whitened with foam by a fierce wind, which here blows with strange regularity."

The Professional Criminal.—In a recent article in Blackwood's Magazine Mr. Anderson discusses the appropriate treatment by the state of the professional criminal, and the ineffectiveness of the present system. In speaking of the sentencing of a criminal of this class, who had previously spent several terms in the penitentiary, to five years' penal servitude, he says: "But have the interests of the community been adequately safeguarded in this case? It may perhaps be urged that such a sentence will be inadequate in deterring others from committing burglaries. But what others? People talk as though the masses of the population were kept from crime only by its penalties. As a matter of fact, crimes of this kind ('burglaries') are the work of professionals. Here, then, is a class of men who have deliberately outlawed themselves. They have had warning after warning, but on each occasion have returned to their evil courses, and now, having been once again brought to justice, the state shuts them up for a few years, and at the end of that time they are to be let loose on society once more to perpetrate a new series of crimes." To illustrate the absurdity of such a proceeding, Mr. Anderson suggests a comparison: If game preserves were being destroyed by a fox, and carefully arranged traps were set at considerable expense to catch him, it would be considered a trifle short-sighted if, after capturing and caging the fox for a time, he were again set free, and the same process gone through with at varying intervals for the rest of the fox's life; and yet this is substantially the process which is pursued by the state with the professional criminal. Most of his class are as hopeless, so far as individual reform is concerned, as is the fox. The whole trend of modern criminology points toward the conclusion that he is a criminal through nature, and is as much of

an abnormity as a maniac or an idiot. In other words, he has a dangerous disease, and should be treated as a diseased member, and not as a mischievous boy. His side of the question, however, is of the least importance; society's first duty is to itself. Individuals who can not live in accordance with the laws which govern civilized societies should be placed where they can do the community no harm. On the other hand, the nonprofessional criminal—who, through some untoward combination of circumstances, in a given instance becomes an offender against the laws—is in quite a different relation to the social body from the hereditary criminal. The former deserves punishment; the latter, treatment. Here, then, besides possible wide individual differences, we have a well-marked class difference among criminals, and it is quite evident that society must consider this class difference in devising successful corrective or protective legislation.

The Chamacocos.—Since the discovery by Dr. Bohls in lagoons in the Lengua territory, near the Paraguay River, of that rare and curious fish, *Lepidosiren paradoxa*, in large numbers, scientists have taken a special interest in this region. Cavaliere Guido Boggiani, an Italian artist, recently spent three years near these lakes, living with two of the native tribes, the *Chamococos* and the *Caduveas*, where he seems to have collected much material of scientific value. Henry H. Giglioli, in a recent Nature, gives an account of the ethnological data gathered during the expedition. The *Chamacocos*, who are especially known to ethnologists through their singular long-handled stone axes, are nomads; they are tall, well shaped, the skin of a reddish tinge. The men have long, black hair, which is worn tied in a knot behind, in a thick queue, or flowing loose. The women are less handsome, and wear their hair short. No clothing is worn by either sex, except rough sandals of peccary skin when on the tramp. On festive occasions they decorate themselves with a profusion of feather ornaments, necklaces of seeds, and the rattle of the *crotalus*, the latter of which are worn in diadems, armlets, leglets, and united in bunches as ear pendants. They make rude pottery, but do not use the potter's wheel. From Boggiani's description the *Chamacocos* seem to be an inoffensive and happy people, who relieve their exuberant spirits in frequent festivities; they have numerous games, one of which might be described as primitive lawn tennis. Their weapons are clubs, wooden spears, large bows for shooting arrows, and small bows with a double string used for shooting clay bullets. The women make neat bags and reticules of different kinds of netting and also hammocks, for which they use the fiber of the *ybira*. They have some curious superstitions regarding food; thus, deer flesh is only eaten by men, while women can feed on birds and small game. Among the many interesting facts collected by Boggiani is a small vocabulary of the hitherto unknown language of these people.

MINOR PARAGRAPHS.

The Bulgarians, according to the report of the United States consul at Annaberg, love music. They sing a great deal, at home, in entertainments, and in their occupations. The shepherds or the harvest-reapers on opposite heights often sing in alternation, stanza in answer to stanza. The attendants and armed escorts of traveling parties raise their voices in chorus, and soldiers sing on the march. Musical instruments are much in use—the primitive native ones, and the modern inventions which are taking the place of these. The predominant national instrument is the *gajda*, or bagpipe, the melancholy and monotonous tones of which are precious to them. Other instruments are the *kaval*, a very simple wooden shepherd's pipe, producing a shrill note; the *gadulka*, or *cigulka*, an instrument of two strings, emitting melancholy tones; the gypsy fiddle, or *kemené*, a superior instrument; the *bulgarina*, a sweet guitar with four strings, which is played upon by means of a goosequill; and the *drukja*, or *bajalma*, a similar guitar, played with two fingers. All the instruments are manufactured by the *gajdari*, who formerly constituted in the town a special guild.

It seems that Prof. Fraser, of Edinburgh, who was recently announced as the perfecter of an antitoxine of snake poison, was anticipated in this discovery by Dr. Calmette, of the Pasteur Institute in Paris. Prof. E. Ray Lankester, in a letter to Nature, says: "In the *Annales de l'Institut Pasteur*, May, 1894, Dr. Calmette described in full detail his researches on snake poison, and demonstrated that not only can animals be rendered resistant to cobra (and other snake) poison by the injection into them of graduated doses of the poison (so that rabbits were rendered tolerant of sixty times the lethal dose), but that the serum of such immunized rabbits is found to contain a powerful antitoxine, which can be used successfully as an antidote to snake poison.

An address, delivered at a presentation to Sir Henry Ackland of a bust and some fifteen thousand dollars which will be employed in carrying on the work of the Sarah Ackland Home for Nurses, stated that the testimonial had been subscribed for in commemoration of the long and faithful service that Sir Henry Ackland had rendered to the university, city, and county of Oxford, and the part which he had borne in the advance of medical science in England, more particularly in the direction of sanitary reform and preventive medicine, during the forty years of his occupation of the chair in the university of Regius Professor of Medicine.

The west coast of Stromö, Faröe Islands, is described by Dr. Karl Grossmann as giving excellent opportunities for studying "how the erosion by sea and weather takes hold of the gigantic rock walls, which look as if built for eternity. The caves, which are produced at sea level by the washing out of dikes and cracks, have often most fantastic forms. Sometimes they are arched like a Gothic vault, resembling Fingal's Cave or Nuremberg architecture; in other parts we see a flat, horizontal roof, covering mysterious inlets, reminding us of the entrance to the lethal chambers of the Pharaohs. In many of these caves seals used to breed, but the irrational way in which the natives slaughtered them has finally driven them away altogether. As we row farther north, we encounter many a fine example of rocks that have been broken off and slid down as stacks, which are now separated from the main rock barely wide enough to admit our small boat."

NOTES.

The acquisition by States of tracts of forest is urged by the friends of forestry as a measure for the conservation of water powers, the amelioration of climate, the preservation of scenery, and the instruction of the people. Aside from the benefit thus derived, it is urged that these forests may be made to yield a fair return upon their cost and maintenance. To illustrate the force of this view, Mr. J. B. Walker, of Concord, N. H., refers to a proposition to form such a park out of the Presidential Range of the White Mountains. The region is already a pleasure ground accessible in twelve hours or less to ten million people. It could be greatly improved and its attractions vastly added to by proper forest development, or, more properly, restoration.

Darwin's suggestion that the composition of subsoils might be ascertained from the examination of the piles of earth brought up by earthworms from their holes is said to have been utilized in Australia by a miner who was led to digging for a coal vein which he found from seeing traces of coal in the accumulations of land crabs; and by another, who, acting upon a hint given him by the wombats, found tin ore in the mountains.

The hot caves of Monsummano, Italy, long neglected, are beginning to receive attention again as health resorts. They were discovered in 1849 by quarrymen, and were found to be helpful to those of the men who had suffered from rheumatism. They were visited by Garibaldi and Kossuth for relief from troubles under which they were suffering. They are hollowed in a porous rock, and an air saturated with moisture circulates freely in them at a temperature of about 88° F. The patient who enters them clad in light robes, soon perspires very freely, and may continue to do so during his whole sojourn of from half an hour to several hours.

The third International Congress of Psychology will be held at Munich, August 4 to 7, 1896. It will be opened on the morning of August 4th in the great "aula" of the Royal University. All who desire to further the progress of psychology and to foster personal relations among the students of psychology in different nations are invited to take part in the meetings.

In a recent letter to Science, Prof. Ira Remsen describes a curious natural gas reservoir. A party of skaters in the neighborhood of Baltimore were upon a large artificial lake which was covered with remarkably

clear ice. In various places white spots were noticed in the ice. Some one bored a hole through one of these and applied a flame to the opening, when a gas jet appeared and burned for some time. The gas, of course, was marsh gas, which had collected under the ice and formed the apparent air bubbles.

The observer who travels about much in the various larger cities of the country, says the Kansas City Architect and Builder, can not fail to notice the marked change that has of late taken place in the construction of large buildings. Everywhere one goes he sees the work going on of putting iron and steel where stone and wood formerly held very much of a monopoly. It is believed by architects and engineers generally to be the beginning of the iron and steel era in building, and that it will go on, becoming more and more general in all classes of building work.

The bad moral effect of a national policy of militarism and an enormous standing army was recently illustrated in the German Reichstag. The question of dueling was brought up by the death of Herr von Schrader, and various methods for stamping out the practice were proposed. It is well known, however, that the emperor approves dueling, and the result of the debate was nil. The imperial chancellor delivered a speech which practically said that public sentiment in favor of dueling was so strong that prohibitive legislation could not be enforced.

The centenary of the introduction of porcelain into France is to be celebrated by an exposition at Limoges this year. The history of porcelain manufacture will be traced by specimens of work and processes. The exposition is being organized by the Société Gay-Lussac, working in conjunction with representatives of the town of Limoges.

The name of the New York Microscopical Society should have been included in the list of the co-operating bodies represented in the Scientific Alliance of New York which was published in the April number of the Monthly.

The deepest hole in the earth has been bored at Parushowitz, near Rybnik, Silesia, to the depth of 2004·34 metres, or 6,514 feet. At that point the drill rod broke off, and the cost of withdrawing the broken end has prevented a resumption of operations. Eighty-three beds of coal were penetrated during the borings, and 384 thermometrical measurements were taken. The latter indicated a very irregular increase of temperature with the depth.

The third International Congress for Psychology, Prof. Dr. Stumpe, of Berlin, president, will be held in Munich, August 4, 1897. The names of Profs. Stanley Hall, of Worcester; Henrik G. Petersen, of Boston; William S. Wadsworth (2); C. Staniland Wake, of Chicago; Mark Baldwin, of Princeton; and Edward B. Tichener, of Cornell, are entered upon the provisional list of contributors of papers published April 15th. The American members of the International Committee of Organization are Profs. Baldwin, H. Donaldson, G. S. Fullerton, Stanley Hall, William James, Lightner Witmer, and Newbold.

Macmillan & Co. announce as in preparation a Dictionary of Philosophy and Psychology, under the editorial supervision of Prof. Baldwin, of Princeton University. It will contain concise definitions, historical matter, and bibliographies on subjects in the whole range of philosophical study (philosophy, metaphysics, psychology, ethics, logic, etc.). Distinguished American and British specialists will contribute original articles to the several departments of the work.

The first session of the Bahama Biological Station was held during the summer of 1893 at Bimini Islands, Bahamas. For the coming season it has been decided to locate the laboratory at Biscayne Bay, Florida, in the latitude of the Bimini Islands, and just across the Gulf Stream. Here are found the same equable climate, clear water, and subtropical fauna and flora for which the Bahamas are famous. The station will be under the direction of Prof. Charles L. Edwards, of the University of Cincinnati, and, beginning June 22d, will continue six weeks. The course of instruction consists of lectures, dissection and microscopic work in the laboratory, with observation of the organisms in natural environment. The fee of twenty-five dollars includes tuition, use of microscope, reagents, and material for dissection. Provisions are made for collecting and preserving representative forms as laboratory material.

Dr. John Russell Hind, superintendent of the Nautical Almanac, who died near the close of 1895, became generally known about the middle of the century by his discoveries of minor planets, which were then few and rare, and by his computations of the orbits of comets and studies in the history of those bodies. He had been a superintendent of the Nautical Almanac since 1853. He received medals for his discoveries, and was elected to many learned societies.

Prof. Adalbert Krueger, of the Observatory of Kiel, and editor of the *Astronomische Nachrichten*, died April 21st, at the age of sixty-four years. He was for many years assistant to Argelander, whose daughter he married at Bonn, then director of the Observatory of Helsingfors, then at Gotha, and lastly at Kiel. As editor of the *Astronomische Nachrichten* and chief of the central office for the telegraphic transmission of astronomical discoveries, Prof. Krueger was brought into relations with the astronomers of the whole world.

WILLIAM WILLIAMS MATHER.

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THE PROPOSED DUAL ORGANIZATION OF MANKIND.

By Prof. WILLIAM G. SUMNER.

RODBERTUS turned aside from his studies of taxation in the Roman Empire, which had shown him the Roman city exhausting and consuming the rest of the Roman world, to express the opinion that the history of the last three hundred years is a story of the exploitation of the outlying continents by the old centers of civilization. This was an attempt to describe summarily the significance for the human race of the opening up of new regions by exploration and colonization. The period during which the influences of the new extension of civilized settlements has been at work is so short that it is impossible to define with confidence its ultimate effects on the relation of the parts of the race to each other, and on the fortunes of the race as a whole. Recent events, however, have forced this subject upon our attention, for the "Monroe doctrine," as it has been recently affirmed and construed, would be nothing less than a doctrine and policy which some people are disposed to force upon the new organization of the inhabitants of the globe produced by the discovery and settlement of the outlying continents. If anybody claims to be able now to take control of this most portentous evolution in the life of the human race, and to dictate the course which it is to take, it behooves us all to verify the doctrine and to test the programme of policy proposed.

The era of geographical discovery and adventure passes for an era of glorious achievement by men, yet to what end did they care to know and reach the outlying parts of the earth? One motive which led them was the gain of commerce. The products of the Indies could be obtained in no other way, and the trade for

them was as old as civilization. The other great motive was to obtain new supplies of gold and silver, under an exaggerated and fallacious notion of the desirableness of those forms of wealth. Starting from these motives the movement has run its own course of commerce, colonization, war, missionary enterprise, economic expansion, and social evolution, for three centuries. The discovery, colonization, and exploitation of the outlying continents have been the most important elements in modern history. We Americans live in one of the great commonwealths which have been created by it. We are hard at work occupying and subduing one of these outlying continents, from a local and later but comparatively old center of civilization. In our own history we have been, first, one of the outlying communities which were being exploited, and then ourselves an old civilization exploiting outlying regions.

The process of extension from Europe has gone on with the majesty and necessity of a process of Nature. Nothing in human history can compare with it as an unfolding of the drama of human life on earth under the aspects of growth, reaction, destruction, new development, and higher integration. The record shows that the judgments of statesmen and philosophers about this process from its beginning have been a series of errors, and that the policies by which they have sought to control and direct it have only crippled it and interrupted it by war, revolt, and dissension. At the present time the process is going on under a wrangle of discordant ethical judgments about its nature and the rights of the parties in it. We are rebuked for the wrongs of the aborigines, the vices of civilization, the greed of traders, the mistakes of missionaries, land-grabbing, etc., yet we Americans and others are living to-day in the enjoyment of the fruits of these wrongs perpetrated a few years ago. The fact is, as the history clearly shows, that the extension of the higher civilization over the globe is a natural process in which we are all swept along in spite of our ethical judgments. Those men, civilized or uncivilized, who can not or will not come into the process will be crushed under it. It is as impossible that the present and future exploitation of Africa should not go on as it is that the present inhabitants of Manhattan Island should return to Europe and let the red man come back to his rights again. The scope for reason and conscience in the matter lies in taking warning from the statesmen and philosophers who have been overhasty in the past with their doctrines and policies of how the process must go on.

Looking at the movement of men from Europe to the outlying continents as a phenomenon in the development of private interests and welfare, it appears at once that the man who went out as a fortune-hunter and he who went out as a colonist are on a very

different footing. The former might be said to aim at selfishly exploiting the outlying country because he hoped, after a few years, to return to Europe and there enjoy his gains. The same could not be said of the colonist, for he cast in his lot with the new country, hoping there to establish a new home for his descendants and to build up a new commonwealth.

If the same movement is regarded from the standpoint of the duties and interests of European states, it is evident that both the fortune-hunter and the colonist needed, at first, the support and protection of the state from which they went forth. The whole movement of discovery and settlement appears, in this point of view, as a manifestation of growing social power in western Europe, and the nations there are seen to have made, in the first instance, a great expenditure of energy and capital for which they never received any return. The relation was one of parenthood, and therefore one of sacrifice on the part of the mother countries. This relation was, however, obscured by traditions and accepted notions of national aggrandizement and glory, and by notions about commerce which were accepted as axiomatic. These notions drove the great states into policies of conquest, exclusion, monopoly, and war with each other. As a consequence, the whole grand movement came to be regarded by European statesmen from the standpoint of gain to European nations, and they adopted sordid measures for snatching this gain from each other. Those statesmen assumed that Europe was the head of the world, and they allotted the outlying regions among themselves with no regard for the aborigines, and very little regard for the colonists. The body of relations which was established between the Old World and the New, under this theory, constituted the colonial system.

It can not be denied that the colonial system stands in history as an attempt to exploit the outlying continents for the benefit of Europe. Thousands of lives and millions of capital were expended in the effort to perfect the system, and in that struggle to steal each other's colonies which the system caused. The logical outcome was the ambition of each competitor to win universal dominion for itself, and to impose a balance-of-power policy on each of the others. The system had its doctrines too; some old, some new: "He who holds the sea will hold the land"—"Trade follows the flag." The English colonial system was far less oppressive and more enlightened than that of any other nation. It alone was founded on real colonization and aimed to create new commonwealths. It was therefore the one under which the system first broke down, for it contained a fatal inconsistency in itself. It educated the colonists to independence, and it was certain that they would go alone as soon as they were strong enough to do so,

if they thought that they were being exploited in the colonial relation. To such extent as this destiny was aimed at or unconsciously brought about, the construction of modern history put forward by Rodbertus fails to be correct.

It has become a common place of history that the revolt of the American colonies was a good thing for the colonies and for England. The question no longer has any other than speculative interest, and perhaps no speculation is more idle than that which deals with the possible consequences of some other course of history than that which actually took place; but, if such speculation ever could be profitable, it would be upon this question: What would have been the consequences to human welfare if the English statesmen of 1775 could have risen to the nineteenth-century doctrine of colonies, and if the whole English-speaking world could have remained united in sympathy and harmony? This question has so much practical value that it may help us to see the advantage there may be in a colonial relation where it still exists, and to see that there is no universal and dogmatic ground for independence which can be urged by a third party.

Independence was brought about on the Western continent; not to any important extent anywhere else. The Spanish-American colonies had grievances against their mother country which fully justified their revolt; still, it appears that they revolted chiefly from contagion and imitation. They have never been able to obtain good standing in the family of nations as independent commonwealths. The Panama Congress of 1824, in its original plan, promised to be a very important incident in the development of the relations of the New World to the Old. It appeared for a time that the Western continent might be organized as a unit in independence of, and possible hostility to, the Eastern continent. The project came to nothing. It was crushed in one of the hardest political collisions in our history, that between the Adams administration and the Jackson opposition. The theory of it, however, remains behind and, under the name of the Monroe doctrine, has remained as a vague and elastic notion. The practical outcome of any attempt to realize that doctrine must be to organize the world into a dual system. Instead of the old notion of a world-unit ruled from Europe as its head, we should have a dual world-system, one half under the hegemony of Europe, the other half under that of the United States. Is this a rational or practicable plan of future development? Is it not fantastic and arbitrary? If the United States pretends to hold aloof from a share in the affairs of the Eastern continent, and to demand that all European states shall abstain from any share in the affairs of the Western continent, is that anything more than a pose and an affectation? Have we not within a year or two been forced to

take action in protection of our citizens in China and Armenia? If Africa is opened up to commerce, do we mean to hold aloof from a share in it? Are we not already deeply interested in it so far as it has advanced? We have interests in Madagascar which have already drawn us into the proceedings there, and which promise to involve us still further. We accepted a rôle in the war between China and Japan which was by no means that of an uninterested stranger. Will any one maintain that we could carry out the policy of abstention in respect to that part of the world?

On the other hand, so long as European nations own colonies in America, how can we rule the Western continent without coming in collision with them? Even if we should dispossess them of those colonies, how would it be possible to rule the Western continent, and to deny them any right to meddle in its affairs, so long as their citizens may visit the same for business or pleasure? The notion that the world can be so divided that we can rule one part and Europe the other, and thus never be brought in collision with each other, is evidently a silly whim. We may talk about "Western civilization" or "American ideas," but these are only grandiloquent phrases. Everybody knows that there is no civilization common to all America and different from that of Europe; there are no ideas common to all America and different from European ideas. There has never been any sympathy between North and South America, and there are only few and comparatively feeble bonds of interest based on commerce or investments. Either North or South America has far stronger bonds to Europe than they both have to each other. As far as the external resemblance of "republics" is concerned, the South American states have hitherto only made republican government ridiculous. The geographical neighborhood, on which stress is often laid, can be seen by a glance at the map to be non-existent. If it existed it would be of little importance compared with economic distance, which is reckoned by cost, time, and facility of transportation. The Western continents are divided from each other by race, religion, language, real political institutions, manners and customs, and, above all, by tastes and habits. They entertain a strong dislike of each other. The United States could never establish a hegemony over the Western world until after long years of conquest. In their quarrels with European states, it suits the South American states very well that the United States should act the cat's paw for them, but it can not be that their statesmen will be so short-sighted as to accept a protection which would turn into domination without a moment's warning; neither can it be possible that our statesmen will ever seriously commit us to a responsibility for the proceedings of South American states.

We may probe the ideas and projects which are grouped under this attempt at a dual organization of the world as we will, in no direction do we come upon anything but crude notions and inflated rhetoric. Such notions have hitherto proved very costly to the human race. President Cleveland, in his Venezuela message, sought a parallel for the Monroe doctrine in the balance-of-power doctrine. The parallel was unfortunate, if it had been true. The balance-of-power doctrine cost frightful expenditures of life and capital, and what was won by them? Where is the balance of power as it was understood in the eighteenth century, or in Napoleon's time? A real parallel to the Monroe doctrine is furnished by the colonial system. The latter, as above shown, was the doctrine of the unity of the world under the headship of Europe. The former is the doctrine of the dualism of the world, with Europe at the head of one part and the United States at the head of the other. One of these conceptions of the new organization of the human race, which is to grow out of the colonization and settlement of the outlying countries, is as arbitrary as the other, and the new one can never be realized without far greater expenditure of life and property than the other. If history and science have any power over the convictions and actions of men, here is a good opportunity for proof of it, for if anything is proved by ecclesiastical and civil history it would seem to be the frightful cost of phrases and doctrines, and of the whole cohort of phantasms which take the place of facts and relations in determining the actions of men. It is to these that men have always brought the heaviest sacrifices of their happiness, blood, and property. We have had in our own history the doctrines of no entangling alliances, State rights, nullification, manifest destiny, the self-expanding power of the Constitution, the higher law, secession, and as many more as rhetorical politicians have found necessary to save them the trouble of coming down to facts and law. How frightful has been the penalty for the people who have been deluded by some of these! Who knows on what day another of them may, by a turn of events, become politically important and call for its share of sacrifice? It is a wise rule of life for a man of education and sense not to allow his judgment to be taken captive by stereotyped catch-words, mottoes, and doctrines.

We have already a commercial system in which we have undertaken to surround ourselves by a wall of taxes so as to raise the prices of all manufactured products twenty-five to fifty per cent above the same prices in western Europe. That system has been adopted as a policy of prosperity to be produced by specific devices of legislation. We have applied it to the best part of the continent of North America. It is now proposed to restrict immigration so as to close the labor market of the same part of

North America, in the belief that wages will thus be raised, and that, if they are, a great advantage will be produced for the wages class. We have also a project before us to inclose all America in a barrier within which an arbitrary circulation of silver money may be secured, all relations with the money of the rest of the world being cut off. That these doctrines and projects all hang together, and are all coherent with the political notion of the dual division of the world, is obvious. The common element is in the narrow and distorted view of what is true and possible and desirable in social and economic affairs.

We have had before us, since the revolt of the English North American colonies, another conception of the organization of human society which is to come out of the extension of civilization to the outlying continents. It is, in fact, now imbedded in international law and in the diplomacy of civilized states. That is why the advocates of the Monroe doctrine have been forced to meet the argument that their doctrine was not in international law by new spinnings of political metaphysics. They have to try to cover the fact that the Monroe doctrine is an attempt by the United States to define the rights of other nations. The modern conception, however, is that the states of the world are all united in a family of nations whose rights and duties toward each other are embodied in a code of international law. All states may be admitted into this family of nations whenever they accept this code, whether they have previously been considered "civilized" or not. The code itself is a product of the reasoning and moral convictions of civilized states, and it grows by precedents and usages, as cases arise for the application of the general principles which have been accepted as sound, because they conduce to peace, harmony, and smooth progress of affairs. The code has undergone its best developments in connection with the spread of enlightenment and the extension of industrialism. This is the only conception of the relation of parts of the human race to each other which is consistent with civilization, and which is worthy of the enlightenment of our age. Any "doctrine" which is not consistent with it will sooner or later be set aside through the suffering of those who adhere to it.

THE citizens of Philadelphia have been reminded by Mr. B. E. Fernow, of the Bureau of Forestry, that that city possesses a forestry reserve of thirteen thousand acres in Centre County, Pa. It was given to the city by Dr. Elias Boudinot, President of the First Continental Congress, as a trust fund for the supply of fuel to poor persons at cost prices. It has been neglected, and much of the timber has been stolen or destroyed; but the work of reforestation was begun in 1888, and has been continued as means have permitted.

SCIENCE AT THE UNIVERSITY OF PENNSYLVANIA.

By LEWIS R. HARLEY, Ph. D.

IN resigning the provostship of the University of Pennsylvania in 1894, Dr. William Pepper defined the broad policy of the institution in the following appropriate language: "The university is truly the voluntary association of all persons and of all agencies who wish to unite in work for the elevation of society by the pursuit and diffusion of truth."

The function of a university is not simply instruction but also research. In this latter field of work American universities are showing great activity, and remarkable results have been produced. The University of Pennsylvania has been particularly susceptible to the changing conditions of American life, as is illustrated in the modifications in its curriculum from time to time. When the institution was chartered as a college in 1755, no other school in this country offered so liberal a course of study. In 1810 the curriculum was modified and rearranged so as to conform to the new conditions which had arisen with the opening of the century; but old methods and old ideas prevailed until 1868, when Dr. Charles J. Stillé was elected provost. The elective system of studies was introduced, and every department of the institution felt the pulses of new life. During the fourteen years of Dr. Stillé's administration the larger career of the university began, and a worthy successor was found in Dr. William Pepper, who was inaugurated provost on February 22, 1881. A new creative period in the history of the university now began, rendered memorable by the founding and equipment of fourteen new departments and the erection of thirteen new buildings. In order to extend its influence as a center of learning and research, the university has aimed to establish the principle that it is organically a part of the municipality of Philadelphia. Fully appreciating the importance of this fact to the city, the Councils in 1872 and in 1883 voted the transfer to the university of splendid tracts of ground in consideration of the establishment of fifty free beds in the hospital for the poor of Philadelphia, and of fifty prize scholarships in the college, to be awarded to graduates of the public schools of Philadelphia. Subsequent accessions of territory from the city authorities have brought the domain of the university up to fifty-two acres in a compact body.

The university is in right, and should be in fact, the crown of the educational system of the entire Commonwealth. The expense of modern research practically necessitates resources which, as a rule, only the State can adequately furnish. But the university received no great contribution from the State until 1779, when

a grant of escheated lands, valued at $66,666.66, was made. No other large appropriation was received until 1871, when the Legislature granted the sum of two hundred thousand dollars for the building of the university hospital. In 1895 another appropriation of two hundred thousand dollars was received from the State for the purpose of improving the college department. By this act the Legislature of Pennsylvania gave complete recognition to the university as a State institution, and at the same

WILLIAM PEPPER, LL. D.,
Provost of the University from January 12, 1881, to June 7, 1894.

time widened its sphere of usefulness. Mr. Charles C. Harrison succeeded to the provostship in 1894, and he at once outlined a liberal policy in an appeal for an endowment fund of five million dollars.

The demand for a special kind of education has been promptly met by the university by the multiplication of new courses of study, three hundred and thirty courses having been offered during the past year. The courses are arranged in elective groups, and the degree of Bachelor of Arts is conferred on graduates who

have taken Latin and Greek during the freshman and sophomore years. The new impulses of the century are shown in the fact that the degree of Bachelor of Science is granted in eight different departments or schools. Besides these, courses are also offered in the Department of Philosophy, the Department of Law, the Department of Medicine, the University Hospital, the Auxiliary Department of Medicine, the Wistar Institute of Anat-

Charles C. Harrison, A. M.,
Provost of the University.

omy and Biology, the Laboratory of Hygiene, the Department of Dentistry, the Department of Veterinary Medicine, the Museum of Archæology and Paleontology, the Flower Astronomical Observatory, and the Department of Physical Education. These various departments at present constitute the University of Pennsylvania.

The highest intellectual life of the university is found in the Department of Philosophy, devoted to the work of research and investigation. The courses are open to college graduates, and

lead to the degree of Doctor of Philosophy. This department, established in 1884, is modeled after the philosophical faculty of the German universities. The growth of the department has been rapid. In 1884–'85 there was one matriculate; during the present year the enrollment has reached one hundred and seventy-one. The possibilities for original work and scientific research in the Department of Philosophy have been greatly increased through the generosity of Provost Harrison, who has presented to the university a permanent fund of five hundred thousand dollars, known as the George Leib Harrison Foundation for the Encouragement of Liberal Studies and the Advancement of Knowledge. Upon this foundation have been established twenty-seven new scholarships and fellowships of the aggregate value of thirteen thousand two hundred dollars annually. The purpose of the adoption of the new system is to build up a group of cultured men residing among the students of the university. The twenty-seven scholarships and fellowships are divided under three classifications. Eight are of the value of one hundred dollars a year, and are open only to graduates of the university, intending to provide for those students who desire to take an extra year of study. Fourteen are fellowships, of the value of six hundred dollars a year, less one hundred dollars devoted to publication, and are open to the graduates of any institution to be held for two years in candidacy for the degree of Ph. D. The Hector Tyndale fellowship in physics, already established, makes fifteen of this grade. Five are senior fellowships of the value of eight hundred dollars a year, open only to those who have taken the degree of Ph. D. at the university. These fellowships may be held for three years, and the holders are required to devote themselves to some work of original research, and to do teaching in the line of their work to a maximum of four hours a week. The intention is evident that the plan aims to retain men of exceptional ability in residence as long as possible. A graduate of the university may hold a scholarship or fellowship for six years, while a graduate of another institution who displays great ability may be retained in residence for five years. Besides the above mentioned, there are also six fellowships in the graduate department for women. It is believed that the university has now the most complete system of fellowships in the country. With a material equipment of grounds, buildings, etc., valued at three million nine hundred and sixty-five thousand dollars, vested funds to the amount of one million nine hundred and ninety-two thousand dollars, the most liberal system of fellowships in the country, a teaching force of two hundred and fifty-one professors and instructors, and a student body numbering twenty-six hundred and thirty-two, the university has peculiar facilities

College Hall.

not only for the work of instruction, but also for research and investigation.

It will be impossible within the scope of this paper to adequately describe all the various activities of the university, so I shall confine myself to those departments in which the chief contributions to science have been made. The Department of Archæology and Paleontology, which illustrates the prehistoric antiquities of America, as well as the remains of highly developed Oriental civilizations, has enlisted the services and energies of the ablest scholars. As a result of their labors, the University of Pennsylvania has put the scientific world under lasting obligations by placing the slumbering witnesses of nations that have perished at the service of science. The Museum of Archæology and Paleontology may trace back its humble origin to the spring of 1888, when a few casts and squeezes of Babylonian inscriptions, some Etruscan and Roman pottery, a number of Palmyrene tombstones, and other miscellaneous antiquities were gathered together and placed under the care of the Professor of Assyriology, Dr. Hermann V. Hilprecht. On October 23, 1889, a little company met at a dinner given by Mr. Francis C. Macauley, at the Philadelphia Club. There were present Dr. William Pepper, then provost of the university; Dr. Joseph Leidy, President of the Academy of Natural Sciences; Maxwell Sommerville, the collector and student of engraved gems; Dr. Daniel G. Brinton, the Americanist; Dr. Horace Jayne, dean of the university faculty; Dr. Charles C. Abbott, the well-known archæologist; Henry C. Mercer, Prof. E. D. Cope, and the host, Mr. Macauley, whose enthusiastic interest in archæological research had led him to bring together these distinguished men of science for the purpose of stimulating and extending the interest in archæological studies, and to establish a museum of archæology in the city of Philadelphia. The project from the first received the cordial support of Provost Pepper, and early in the month following it was announced that the university had established the Museum of Archæology and Paleontology, for which a staff of officers was appointed and Dr. Charles C. Abbott installed as curator.

The formation of a museum, however, had only been part of a scheme in which a most important place had been given to the prosecution of original investigation and the arousing of a more general interest in the subject of archæology. To obtain funds for prosecuting explorations and to enlist the support of people of cultivated taste in the work, a society was formed under the title of the University Archæological Association. This organization, which now numbers over two hundred members, has largely contributed to the results achieved. In 1891, in consequence of the great interest manifested in the museum and the successful ex-

tension of its work, it was constituted a department of the university. Its collections are now contained in halls devoted to them in the library. They comprise eight sections, each in charge of a curator, as follows: American and Prehistoric Archæology, Asian and General Ethnology, Babylonian Casts, Egyptian and Mediterranean Glyptics, Musical Instruments, and Paleontology.

The American Museum occupies a spacious hall. Long rows of flat cases fill the center of the room. In these are contained a carefully arranged collection of the objects of stone, bronze, bone, and pottery which comprise the few material evidences of the presence of man on the eastern part of this continent before the arrival of European settlers. There are displayed the rude stone implements from the Trenton gravels, the discovery of which carried back the antiquities of man in America to a period hitherto undreamed of, constituting an era in the science of American archæology. There are also finished stone implements of the recent Indians, and the fragments which alone remain of the rude Indian pottery. These specimens are arranged State by State through almost the entire Union. The exhibition space is at present chiefly occupied with the Hazzard collection from the cliff dwellings of Mancos Cañon in southwestern Colorado. Here, under the wide dome of the Library building at the university, is a little colony of people and things estimated to be two thousand years old. The village was discovered by two brothers named Wetherile, in 1888, in the heart of the cañon of the Mancos River in Colorado. They bought up the village at a very low figure, and sold it to Mr. C. D. Hazzard, of Minneapolis. Mr. Hazzard showed a part of his wonderful collection at the World's Fair, and Mr. Stewart Culin, of the university, secured it for exhibition in the museum. The collection represents in an almost unbroken series the entire life of these strange people, telling in plain words more about them than we know now about the warring Indian tribes which inhabited the eastern coast of North America. This exhibition shows that in the wilds of the Rocky Mountains, where this curious colony of people were driven for refuge by the wilder tribes inhabiting the plains, there existed two thousand years ago a civilization and a culture that will bear comparison with its contemporary countries throughout the world. The Mexican antiquities consist chiefly of objects from graves, among which are a number of cinerary urns, with their original contents of calcined human bones. From Peru there is a highly important collection of pottery from the ancient sepulchres, with mummies and a number of the simple objects, such as food, weapons, and household implements, which the Peruvians were accustomed to bury with their dead. From the islands of the Pacific may be seen the weapons and pottery, the carvings of

Museum of Archæology.

wood and bone, the ornaments, headdresses, and costumes—all, in fact, that made the savagery of those strange lands of the South Sea so remarkable and distinctive. In it is reflected the spirit of that island civilization that spreads from the far South to the Alaskan shores of the Pacific.

The results of the explorations conducted by the department in Florida, the caves of the Ohio Valley, and in Yucatan have been of the greatest scientific importance. The explorations of Mr. Charles B. Moore in the shell mounds of Florida produced a case of selected objects which filled a most important gap in the collection of the American department. During the past few years Mr. Henry C. Mercer, Curator of American and Prehistoric Archæology, has visited the most important prehistoric sites of Europe. The university museum has thus been enriched by European collections, such as are to be found in no other museum in America. He made sketches of French caves, where the oldest objects of human skill have been discovered, and where pictorial art of a striking character has been found in drawings upon the bones of the mammoth and the cave bear. Mr. Mercer has also explored the floors of the mountain caves of Yucatan for traces of pre-Indian occupation, continuing the systematic search for evidences of the existence of palæolithic and glacial man, which he had carried on with negative results in the Ohio and Mississippi Valleys. The caves yielded nothing older than the pottery of the Maya Indians of the time of the conquest, verifying Maya traditions that they found the country uninhabited when they entered it, ages ago, from the North. Mr. Mercer's observations have practically demonstrated that the antiquity of man in America is more recent than in Europe, as shown by the human remains found in European caves.

No piece of work done in America in a decade has so elevated the European estimate of American scholarship as the recent explorations in Babylonia under the auspices of the university. In the summer of 1888 the University of Pennsylvania equipped and sent out the first American expedition to the northern half of the plains of Babylonia to effect a thorough exploration of the ruins of Nippur. A short time before this a few citizens of Philadelphia had met in the house of Dr. William Pepper and formed the Babylonian Exploration Fund, with the purpose of effecting a systematic exploration of ancient Babylonia. Two professors, Dr. J. P. Peters and Dr. Hermann V. Hilprecht, were intrusted with the management of the expedition. The explorations were conducted amid the greatest difficulties, the chief ones being the deadly climate and the hostility of the natives. But the excavations were pressed on with energy and confidence, under the gracious protection of the Sultan of Turkey and Hamdy Bey, the Director-

General of the Imperial Museum in Constantinople. The explorers penetrated deeper and deeper into the secrets and riddles of the huge mound of ruins at Nippur. Hundreds of graves, clay coffins, and urns were opened, and the ruins of demolished habitations and storehouses, along with the contents of their chambers, were explored. In this way thousands of documents, inscribed bricks, vases, and votive tablets were collected. Evidences of the activity which once pulsated in the streets of the city were unfolded before the eyes of the restless explorers. The terraces of the Temple of Ekur were disclosed. Numerous bricks bearing the name of the great Sargon came forth to the light of day under pickaxe and shovel. Under the building of Sargon one of the most important finds rewarded the labor that had been expended. An arch of brick was laid bare, and by this the question long discussed by the historians of architecture as to the antiquity of the arch entered upon a new stage, and its existence in Babylonia at the beginning of the fourth millennium before Christ was proved. The excavations have not yet reached the deepest foundations of this venerable sanctuary, whose influence for over four thousand years had been felt by all classes of the Babylonian people. But in the presence of this fact we begin to have some notion why Nippur is spoken of as the oldest city of the earth in the old Sumerian legends of the creation. Nearly seventy thousand dollars have already been spent on the excavations in Nippur, and great sacrifices of time, money, and personal devotion will be needed to carry the exploration to its end. Among the most important objects secured for the university museum may be mentioned about thirty-five thousand cuneiform documents in clay. The Babylonian Museum is the most important in America, and ranks immediately after the British Museum and the Louvre.

The classification and editing of the numerous and important results of the expedition has been intrusted to Prof. Hilprecht, who has planned their publication in four series of from ten to fifteen volumes each. Two volumes have appeared already, three are in the press, while seven others are in preparation. During the summer of 1893 Prof. Hilprecht was sent to Constantinople by the Babylonian Publication Committee to examine the inscriptions of the cuneiform tablets which had been deposited there according to the laws governing the disposal of such objects in the Turkish Empire. Hamdy Bey, Director-General of the Imperial Ottoman Museum, requested Prof. Hilprecht to reorganize the Semitic section of the Imperial Museum and furnish the basis of a catalogue of that section. Dr. Hilprecht complied with the request, and since that time he has acted as curator of the section. In March, 1896, Dr. Hilprecht again sailed for Constantinople to

classify and read the cuneiform documents excavated during the last two years in Nippur. During the summer he will also complete the reorganization of the Semitic section of the Ottoman Museum.

The lectures of Miss Amelia B. Edwards, in the fall of 1889, aroused considerable interest in the subject of Egyptology. Several thousand dollars were contributed by the Archæological Association, and the work of excavation was begun by Flinders Petrie. Valuable collections of Egyptian antiquities were received in return at the end of the seasons, and Mrs. Cornelius Stevenson was elected curator of the newly formed Egyptian section.

Egyptian Hall—Museum of Archæology.

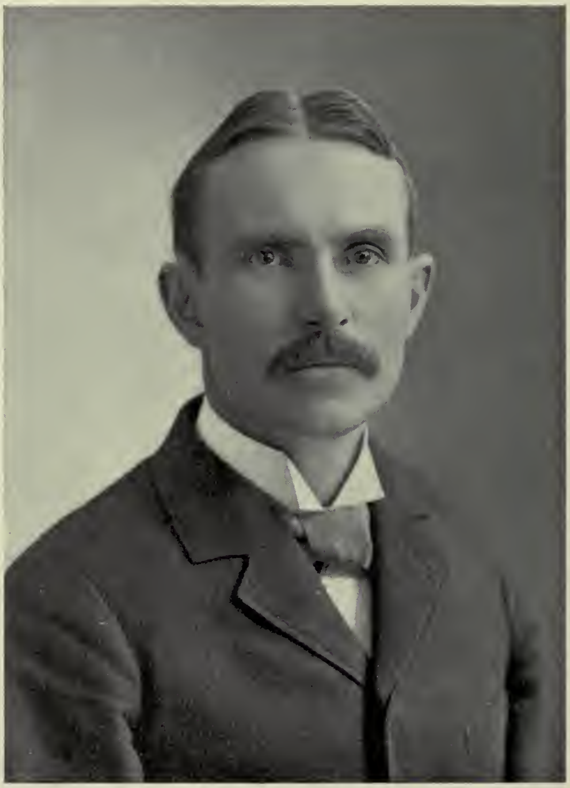
The museum contains a historical and industrial series of Egyptian objects from the fourth dynasty down to the Ptolemaic times. A collection placed on exhibition March 20, 1896, is of the greatest interest to science. Things sunk to earth between the years 2800 and 3500 B. C., illustrating the life of the Libyan invaders of Egypt, were brought to light a year ago by Flinders Petrie, the explorer. About thirty miles from Thebes, in the oldest Egyptian tombs, a most unexpected and startling discovery was made. There were found burials of strange un-Egyptian interlopers, whose large numbers and peculiar mode of disposing of their remains, as well as the implements, pottery, stone work, etc., composing their funeral deposits, show them to be not only intruders, but intruders who had once swept over the region, bor-

rowing little or nothing from the people whose land they occupied. The recent exhibition is of the utmost interest to scientists, as it throws light upon the darkest age of Egyptian history, bringing us into contact with the neolithic culture of Europe, which we find transplanted at that remote period upon the banks of the Nile, and it gives us the means of tracing connections with the products of the Mediterranean peoples back to at least 3000 B. C.

The work of the museum has grown so rapidly that, in spite of the liberal accommodations allowed the department in the new Library building, only a portion of the material can be exhibited, and even the facilities for storage are becoming wholly inadequate. As early as 1893 the project of erecting a museum building for the suitable display of the collections was taken up by Mrs. Stevenson. Through the influence of Dr. Pepper, the city authorities conveyed to the university a tract of land for the purpose of establishing thereon a free museum of art and science. In 1895 the trustees of the university applied to the Legislature for an appropriation, one hundred and fifty thousand dollars of which is to be devoted to the erection of this building. Plans have been adopted, and ground will be broken soon. The entire scheme as proposed represents an outlay of about two million dollars. Here will arise one of the most important adjuncts to general culture, not only for the students enrolled upon the college register, but for people of intelligence throughout the city, the State, and the entire country. This department receives no return from students in fees or emoluments. It is a gift to them and to the public, supported entirely by private benevolence.

Literature and philosophy form subjects of investigation just as interesting as any other evidences of civilization. The important place of modern languages in the college curriculum has attracted a great measure of attention in recent years. Although at first introduced from the standpoint of utility, they have come to be treated as languages to be investigated philologically, and as possessing literatures to be studied historically and critically. The University of Pennsylvania has been foremost in taking this view of the modern languages. By the Professor of German and the recently added Professor of Romance Languages both French and German philology are taught, courses in Gothic and old French being offered to such as desire them; and in both languages, as well as in Italian, the literature receives full attention. English, by the addition of courses in Anglo-Saxon and English philology, has followed in the same direction. Students may now not only obtain large practical drill in the use of their mother tongue, but may also learn something of its origin, its history, its growth, and of the linguistic laws that govern it. Sanskrit sup-

plies the necessary stepping stone for the study of comparative philology, while Hebrew paves the road for any who desire to enter upon the field of Semitic studies. The youngest daughter of Philology—Assyriology—has attained full development with surprising swiftness, and the ruins of a highly developed civilization have been unearthed, accompanied by a unique literature graven in stone and clay. The ancient history of Western Asia has for the first time been placed on a sure footing, thus enabling



Rev. George S. Fullerton, Ph. D.,
Vice-Provost of the University.

us to write one of the earliest and most important chapters in the history of our race.

The university is at present doing much valuable scientific work in the history of philosophy, psychology, and pedagogy. Dr. George S. Fullerton, Professor of Philosophy, conducts a graduate course in ancient, mediæval, and modern philosophy, attended by more than sixty students, many of them being connected with the public-school system of the State either as

superintendents or principals of schools. Dr. William R. Newbold, Assistant Professor of Philosophy, is carrying on investigations in a field of natural science in which results are hard to attain. An inquiry into the character and condition of states of belief, undertaken some seven years ago, led him to the study of the active side of mind in general, with special reference to the origin and function of its more complex elements, such as states of belief, practical intuitions, ethical conceptions, choice, and reasoning. Dr. Newbold is working upon these problems from such points of vantage as may be offered by the study of the less highly evolved forms of consciousness, as in the lower animals and in children, and in those disintegrations of the more complex forms found in hysteria, epilepsy, trance, and hypnotic states. The greater part of Dr. Newbold's work, however, is not yet in shape for public use, and is not likely to be for several years to come.

In no department of the university has there been a greater advance in improved methods than in psychology. With the growing equipment of the university in laboratories, museums, and library, it has become possible to put new methods into efficient practice. By experimentation in laboratories the students are brought into close personal contact with the subject-matter of their studies. A student of psychology has open to him the courses delivered in the medical school on anatomy and physiology, and he has opportunities for dissection. He may attend clinics at which nervous patients are treated, and he has courses to choose from on mental pathology. There are opportunities to become familiar with the types of mental diseases by actual inspection of cases, and within easy reach are asylums for the insane and institutions for deaf-mutes and for the blind. The department of Experimental Psychology at the university was organized for the prosecution of original research, and for the teaching of psychology to undergraduates and to graduate students. The laboratory is the oldest in continuous existence of all American laboratories of psychology in which regular courses for students are offered. It was founded in 1887 by Profs. Cattell and Fullerton. The former was a student of Wundt's in Leipsic, where he was the first assistant in the Psychological Institute. He was the first Professor of Experimental Psychology at the university, and introduced the research and demonstration methods of the German laboratory. Dr. Lightner Witmer, the successor of Dr. Cattell, was a student of his, and also of Wundt. Thus the laboratory of psychology at the University of Pennsylvania was one of the earliest outgrowths of the great foundation of Prof. Wundt at Leipsic. The German laboratory is more of an institution for conducting and encouraging original research than for giving instruction. The American laboratories tend to subordinate

original research to teaching, or at least equal prominence is given to both. The psychological laboratories at the university are situated in the biological building. Psychology, as one of the sciences of human life, thus takes its place among the other biological sciences. Its connection with philosophy has been a close one, and will probably always remain so. Physiological and experimental psychology are required courses in the philosophy group of undergraduate studies, as well as forming parts of the natural history and biological courses. The work of this department consists of undergraduate courses in physiological and

Laboratory of Experimental Psychology.

experimental psychology and graduate courses of comparative studies of systems, child psychology, and laboratory work. The laboratories have a complete equipment of all necessary apparatus, including instruments for measuring the time it requires to react to a sound, light, touch, or electric spark. The essential instruments of the series are two time-recording devices, the chronoscope and the chronograph. By means of many experiments with the chronoscope, it has been found that multiplication and division are longer processes than addition and subtraction. Thus, it takes every subject a little longer to think that two times five is ten than that two plus five is seven. Experiments with the chronoscope are being made on the simple reaction time of all classes of persons, and on the time that it requires them to perform simple movements. The movements tested are of the right

and left hand, both from the body and toward the body. It is found that Indians are the shortest reactors, but they can not make the movements of the arms much more rapidly than whites or blacks. Experiments are also being made for the purpose of studying the effect of mental states upon muscle contractions. If the tendon just below the knee-cap be struck, it is known that the foot kicks out. This is called the knee-jerk. It varies greatly from time to time in amount. Mental conditions affect it; a sound or an intense light will increase it. Many experiments show that a mental state instantaneously alters the conditions of muscle contractions, even though such muscle contractions be not directly associated with that mental state.

Pedagogy is a subject closely related to philosophy and psychology, but its introduction into American universities is comparatively recent. Probably the University of Michigan first demonstrated what could be done in a strictly professional way to fit young men and women for the best positions in the school system, when, in 1879, the department of the Science and Art of Teaching was organized. The subject was brought into prominence at the University of Pennsylvania in 1891, when the Public Education Association of Philadelphia appropriated two hundred and fifty dollars toward the establishment of a chair of Pedagogy in the university. This was followed by a sufficient appropriation by the university to establish such a professorship, beginning in the autumn of 1894. Dr. Martin G. Brumbough was called to the chair, and in one year the wisdom of establishing the new department has been demonstrated. Graduate courses in the institutes and the history of education are offered, besides which there is a Saturday class open to the teachers of Philadelphia and vicinity. The enlargement of university Pedagogy has been one of the great needs of the State and the nation, and the present movement will result in calling to the university the best men to examine these questions in their universal relations and study education as philosophy.

While the departments of History and Politics are not within the scope of this paper, the sociological field work, recently begun by Dr. Samuel M. Lindsay, of the Wharton School of Finance and Economy, promises results of the greatest interest to science, and deserves a brief discussion here. Dr. Lindsay studied sociological methods in Paris and other European cities. In 1894, Prof. M. Cheysson, of the *École libre des sciences politiques* at Paris, made a splendid beginning in the way of sociological field work. With his students, regular excursions were made to the shops, schools, restaurants, stores, and factories of the city. In every case the students came away with valuable impressions and new light on the many problems of the management of labor. At present Dr.

Lindsay is carrying out a similar plan of sociological excursions at the university. Regular trips are made to the large business establishments, and to the various charitable and reformatory institutions, slum districts, etc. A thorough investigation of the condition of the colored population of Philadelphia is contemplated in the near future. An assistant in sociology is to be appointed for next year, whose special work will be an investigation of the negro, Italian, and other foreign population. The College Settlement Association of Philadelphia will co-operate with the university in this work, by furnishing an assistant in carrying on the proposed investigation.

An important contribution to science has recently been made by Dr. George E. Fisher and Dr. Isaac J. Schwatt, of the mathematical department of the university, in their translation into English of Durège's Elements of the Theory of Functions. Dr. Schwatt has also written A Geometrical Treatment of Curves which are Isogonal Conjugate to a Straight Line. This work called forth the following commendation from the eminent French mathematician Vigarié: "The work has been admirably conceived, and in my belief it is the first essay of the kind that has ever been published."

As early as 1775 David Rittenhouse, sometime vice-provost, published an oration on astronomy, but wrought more than he wrote. The erection of an astronomical observatory as a department of the university has been an unfulfilled desire until the present. In 1876, Reese Wall Flower, of Delaware County, Pennsylvania, bequeathed to the university a large sum of money for the erection of an astronomical observatory. Among the assets turned in to the university as a part of this sum was the farm in Delaware County known as the Flower farm. It happily offered the most available site for the observatory, the erection of which is now under way. The observatory buildings, three in number, consist of the equatorial building, the meridian building, and the residence of the director, Prof. Charles L. Doolittle, late of the Lehigh University. The principal instruments comprising the equipment are an equatorial of eighteen-inch aperture, with spectroscope; a meridian circle and a zenith telescope; and a three-inch universal transit. Graduate students in astronomy will be instructed in the details of observatory practice, and will be expected to participate in the regular work. The outlined plan contemplates systematic observation of comets and small planets, investigation of various latitudes, and spectroscopy. A small observatory for the convenience of undergraduate students will also be erected in the Botanical Garden on the university grounds, thus making the large observatory free for advanced work.

The John Harrison Laboratory of Chemistry, recently added

to the group of imposing university buildings, affords superior facilities for scientific research and investigation. This large building contains on the first floor a laboratory for beginners that will accommodate over three hundred persons. There are also assaying rooms provided with twelve large furnaces, a balance room, a gas-analysis room, and a technical laboratory where preparations can be made upon a large scale. The second and third floors contain museums, lecture rooms, and private laboratories for advanced students. Electrolytic work is a leading feature in the laboratory. Since 1888 sixty-three investigations have been made relating to the use of the electric current in the

Biological Hall, University of Pennsylvania, Philadelphia.

determination and separation of metals. These include studies in the above, and also in derivatives of what may be called the rare metals. At present, important investigations are being made in the following subjects: Electrolytic determination of the atomic weight of mercury; atomic weight of arsenic; and two investigations involving a study of the very rare minerals columbium and tantalum. Within the past few years, nine important theses, the work of graduate students, have been published, and at present there are fifteen persons pursuing chemistry as a major subject for the Ph. D. degree. Dr. Edgar F. Smith, the Professor of Chemistry, is much interested in special electrolytic work.

His book on Electro-Chemical Analysis has recently been translated into German by Dr. Max Ebeling, of the Technical School of Berlin.

For more than a century and a half Philadelphia has evinced a profound tendency toward studies in the natural sciences. Bartram's Botanical Garden was started in 1728, and Marshall's in 1773. During the past century the university made repeated attempts to establish studies in the natural sciences, and these efforts were finally ended, in 1884, in the organization and opening of the Biological School. Just before this, Dr. Horace Jayne, of the university, had gone abroad to examine the most celebrated

Wistar Institute of Anatomy and Biology.

laboratories of the Old World. He became fully convinced of the need in Philadelphia of a well-equipped biological school, separate and distinct from any other. He gave himself to the task of developing the school, and Provost William Pepper joined heartily in the movement. Although the services of the Philadelphia Academy of Natural Sciences have been vast, its legitimate work has been only original investigation. The general scientific instruction in classes and by laboratory work remained for the Biological School to do. A further advance in higher education was made by opening the school to both sexes alike. In this school has been developed a complete system of education, different from but equal in value to the ordinary college course.

It fills a long-felt want in higher education, by allowing youth of different predilections a choice between two equally valuable lines of mental training. The laboratories of the school are thoroughly equipped with material for research and investigation. The museums are rich in complete articulated skeletons for the study of comparative osteology. The conservatory is filled with a representative collection of plants, and botany is studied from the living organisms. The Botanical Garden, which of late years has not been improved, owing to the lack of funds, is now being beautified by laying out paths, erecting mounds, and the construction of an artificial lake. Dr. Macfarlane, the Professor of Botany, anticipates making it one of the best botanical gardens in the country. For the purpose of procuring rare seeds to place in the garden, Dr. Macfarlane has prepared a list of eight hundred different kinds of seeds to be exchanged with botanical gardens throughout the world. Within the past two years one thousand different kinds have been received from twenty-one gardens located in America, Europe, and Asia. A number of original investigations have been conducted in the school which have produced important economic and scientific results. These studies, published in the contributions from the Botanical and Zoölogical Laboratory, consist of Maize: A Botanical and Economic Study, by Dr. John W. Harshberger; The Correlations of the Volumes and Surfaces of Organisms, by Dr. John A. Ryder; The Embryos of Bats, by Dr. Harrison Allen; and a number of other important works.

Medical science at the university assumes great importance, on account of its early historical foundation. A great stride has recently been made in the progress of the science at the university by the establishment of a four years' course of study and by the opening of new laboratories and museums for research and investigation. The instruction of the medical department of the university is conducted in the Medical Hall, Laboratory Building, the University Hospital, the Pepper Laboratory of Clinical Medicine, the Laboratory of Hygiene, and the Wistar Institute of Biology and Anatomy. It will be impossible even to enumerate all the researches and investigations made in the various medical laboratories. The subject of medical chemistry has for many years been given great prominence. Since 1818 this chair has been held in succession by Dr. Coxe, Dr. Robert Hare, Dr. James B. Rogers, Dr. Robert E. Rogers, and Dr. Theodore G. Wormley, the present incumbent, who was elected in 1877. Dr. Wormley has attained a world-wide reputation by his work on The Micro-chemistry of Poisons. The course in chemistry amounts to three hours' work per week for two years. There are two chemical laboratories in the medical department, in which practical exami-

nations are made of urine and animal fluids, and of the recognition and recovery of poisons from the animal body. This work is supplemented by a lecture course for two years. Realizing the importance of the subject of medical chemistry, the university authorities are contemplating the erection of a new laboratory equipped with every modern appliance and facility for original work. Perhaps the most important contribution from the Laboratory of Physiology since 1879 is the memoir on the Venom of

Theodore G. Wormley, LL. D.,
Professor of Chemistry and Toxicology, Medical Department.

the Rattlesnake, by Dr. S. Weir Mitchell and Dr. Edward T. Reichert, in which it was shown for the first time that the toxic principles of venom are albuminous substances, and this laid the foundation of the enormous amount of work in the development of our knowledge of toxalbumins, etc. The Wistar and Harner Museum, founded nearly a century ago, is the largest and richest of the kind in the United States, containing not only a great variety of specimens illustrating the normal and morbid anatomy of

every part of the human body, but also a large number of preparations in comparative anatomy. In 1892 the Wistar Institute was established, being the first in America open to the public. General Isaac J. Wistar has given to the Institute a large and costly fireproof building, together with a sufficient endowment to provide means for the original work for which it is intended. While the museum is free for the inspection of all teachers and students, the object of its laboratories is to afford facilities to advanced students only, and the institute is not to supersede the elementary instruction of undergraduate students of the university.

The university aims not only to equip physicians with the skill to combat disease, but also to send forth missionaries of health to provide for the hygienic needs of the people. For this purpose, in 1892, the Institute of Hygiene was established. The discoveries of Pasteur led up to Koch's convincing proof of the part played by minute organisms in the causation of tubercle. One disease after another has been traced to its cause in some tiny agent of mischief. Realizing the value of the many ways thus open to beneficent knowledge, Mr. Henry C. Lea offered to provide the means for the construction of a building for the Institute of Hygiene. The building was completed in 1892, and Dr. John S. Billings became the director. The laboratory is the first structure of its kind erected in the United States, and it opens a comparatively new field of work in this country. Regular courses are given in practical hygiene, bacteriology, and physiological chemistry. The following important investigations have already been made: Sewer gas—a chemical, physical and bacteriological investigation, by Dr. A. C. Abbott, First Assistant; a chemical and bacteriological study of the Schuykill and Delaware water supply of Philadelphia, by Dr. J. H. Wright, Scott Fellow, 1892–'93; investigation into the nature and cause of membranous rhinitis, by Dr. M. P. Ravenel, Assistant in Bacteriology; investigation on the influence of light on bacteria, by Dr. J. S. Billings and Dr. A. W. Peckham. The most important contribution to science from the new Laboratory of Hygiene is the one recently made by John S. Billings, M. D., S. Weir Mitchell, M. D., and D. H. Bergey, B. S., M. D., Assistant in Chemistry in the Laboratory, on the Composition of Expired Air and its Effects upon Animal Life. This valuable study has been published under a grant from the Hodgkins Fund of the Smithsonian Institution. The results obtained in this research indicate that in the air expired by lower animals or by man there is no peculiar organic matter which is poisonous to the animals mentioned, excluding man, and that the injurious effects of such air appeared to be due entirely to the diminution of oxygen or the increase of carbonic acid.

The establishment of the Laboratory of Hygiene was the be-

ginning of the realization of a fond dream that Dr. William Pepper had entertained for many years, that a happy time would come when well-equipped laboratories with adequate endowment would offer the chance for original investigation in medical science. The establishment of this laboratory was followed by Dr. Pepper's gift of the Laboratory of Clinical Medicine, in 1895, founded in memory of his father, the late Dr. William Pepper. The laboratory is a large building of four floors, admirably adapted to the purposes of original work. The gift is unique, in that

Laboratory of Hygiene.

it is made for the specific purpose of promoting and stimulating original research and improvements in methods of diagnosing and treating the diseases of human beings, and of giving advanced and special instruction to men who have already obtained the degree of Doctor of Medicine. The University Hospital will thus serve new uses in the promotion of knowledge, and the investigating laboratory in close connection gives the strongest possible expression to the influence of scientific work upon practical medicine. Dr. William H. Welch said, "To the small number of existing clinical laboratories, the William Pepper Laboratory of Clinical Medicine is a most notable addition, being the first laboratory of the kind in this country, and it is not surpassed by any in foreign countries."

The twelve years' existence of the veterinary department of the university has measured the most eventful and prosperous period

in the history of veterinary science in this country. Among the most valuable results of veterinary work at the university have been the introduction in this country of some of the successful practices of foreign veterinarians in regard to the suppression of diseases among animals and their transmission to men. In this connection the most noted achievement has been the introduction of tuberculin as a diagnostic for detecting tuberculosis in cattle. The valuable and well-known experiments of Dr. E. O. Shakespeare on infectious diseases of swine, and on tetanus, were also conducted at the veterinary department of the university.

The university has taken a new departure in order to make its treasures of art and science accessible to the people. Systematic Saturday courses were opened in the college two years ago for teachers unable to take the regular graduate work of the university. These courses have become so popular that one hundred and eighty-one teachers are now doing special work in the various departments. Estimating that each teacher represents forty pupils, the university, by means of these special courses, exerts a direct influence on more than seven thousand individuals. Dr. Edward Brooks, Superintendent of the Schools of Philadelphia, stated recently that the city school principals in Dr. Fullerton's graduate class alone represented twenty-five thousand pupils. This is but one step toward giving to the general public a share in university instruction, too often restricted to a few. With free museums, new laboratories and new methods, and more liberal encouragement from the State, the university is rapidly approaching the ideal expressed by Prof. Calvin Thomas:

> A university in the German sense is an institution crowning the educational system of a state, treating its students as free adults engaged in a *bona-fide* pursuit of knowledge, offering its advantages at the lowest possible price, sending down its roots into the life of the people, to take thence the sap of its own vitality, and paying back the debt by raising the level of intelligence and adding to the value and dignity of life throughout the entire Commonwealth.

Provost Harrison's great influence with the people of Philadelphia, with his own generosity, has resulted in gifts to the university during the past two years of one and a half million dollars. University instruction, from its very nature, can not be self-supporting, for universities are, after all, charities on a large scale. The recognition which the university is now obtaining from the city gives us every reason to believe that the efforts of the provost will make it possible for us, within the next few years, to do for the educational life of the community, in an adequate degree, what a university as a center of higher culture should do, and at the same time to make large contributions to the sum of human knowledge.

PRINCIPLES OF TAXATION.

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II.—THE PLACE OF TAXATION IN LITERATURE AND HISTORY.
PART VII.

THE TAX EXPERIENCES OF SWITZERLAND.—Any review of the notable experiences of the Governments of different countries in raising revenue for their maintenance and support would be incomplete if it failed to notice those of Switzerland, where the conditions involved are, to say the least, exceptional, or different in many respects from those of any other government or country. These conditions, stated briefly, are as follows:

A country of comparatively small area—15,964 square miles—and in no small part uninhabitable and practically inaccessible, with a population in 1894 of about 3,000,000 (2,986,848). These conditions may be best appreciated by the following comparisons: Of the four countries that are immediately contiguous to and bound Switzerland, France has an area of 204,092 square miles and a population of 38,343,192; Germany, 208,738 square miles and a population of 49,428,470; Austria-Hungary, 264,264 square miles and 40,810,916 population; and Italy, 114,410 square miles and 29,699,785 population. A comparison with some of the States that in the aggregate constitute the United States also affords the following results: The whole of Switzerland has about one third of the area of the State of New York and one half of its population; one sixteenth of the area of the State of Texas; less than one third of the area of the State of Georgia, etc.

Of the total area of Switzerland, only seventy-two per cent, or an area about as large as the States of Massachusetts, Connecticut, and Rhode Island combined, is classed as habitable and productive; and the soil of this portion does not yield sufficient for the support of more than two thirds of the population, a large percentage of the remaining third finding employment and support mainly in very small industries, occupying only a family. The position taken by Switzerland in the trade and commerce of the world is most remarkable, especially when the various natural obstacles are considered—such as the absence of raw material for her industries, asphalt being the only raw mineral product of which the export exceeds the import—the costly and difficult means of transport, and the restrictive customs established by neighboring and bounding countries. Thus, a comparison of the exports of different countries, in proportion to their population, of manufactured products to the world's markets, shows that

Switzerland takes the lead in respect to values; namely, $37 per capita per annum.

Of other countries, the Netherlands comes next to Switzerland, with a present annual export valuation of manufactured products of $35.60 per capita; then England, $24.60; Belgium, $23.40; Germany, $11.50; France, $11; Sweden, $7; Norway, $4.60; and, finally, the United States, with $3.40.

In respect to comparative aggregate valuations, Great Britain furnished nearly thirty per cent of such exportations; Germany nearly eighteen per cent; and France thirteen per cent, making about sixty per cent for these three countries. The proportionate valuation of the United States for 1894 was 12·16 per cent.*

The principal articles of Swiss exportation are cotton fabrics (printed and embroidered), silks (especially ribbons), food stuffs, cheese and condensed milk, clocks and watches, machinery and carriages, works of art, mineral waters, straw goods, etc.

The leading characteristics of the people of Switzerland are their habits of persistent industry, the practice of rigid economy (in great part by reason of necessity) in their expenditures, a degree of patriotism that is everywhere exhibited and acknowledged, and a remarkable diversity of language. "Three tongues have existed side by side in Switzerland for centuries, and their individuality is recognized in the Federal Constitution, by providing that laws shall be printed in all of them, and that in the distribution of certain offices regard shall be paid to the language of the people for whose benefit the official serves.† Education is compulsory; primary education is free, and the percentage of illiteracy is small—almost nothing.

Their standard of morality may be indicated by the circumstance that about five per cent of the births are reported as illegitimate.

The present political organization of Switzerland closely resembles that of the United States, but is far better entitled to the claim of being free and democratic, and in this respect is probably typically superior to any other Government that exists or ever has existed.‡ Under the present Constitution, adopted in 1874,

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* Address of Theodore Search, President of the National Association of American Manufacturers.

† State and Federal Government in Switzerland. By John Martin Vincent. Johns Hopkins Press, Baltimore, 1891.

‡ "The county, State, and Federal Governments (of the United States) are not democracies. In form they are quasi-oligarchies composed of representatives and executives, but in fact they are frequently complete oligarchies, composed in part of unending rings of politicians that directly control the law and the offices, and in part of the permanent plutocracy who purchase legislation through the politicians." The Initiative and Referendum in Switzerland. By J. W. Sullivan. Nationalist Publishing Co., New York, 1893.

and which practically reaffirmed previously existing conditions, Switzerland became a federated republic, whose proper and official designation is the "Helvetic Confederation," consisting of twenty-two Cantons or States; although the division of three cantons into two demi-cantons makes the total number of federative units twenty-five. The several Cantons elect a Federal Assembly (*Nationalrath*) and a States Council (*Ständerath*) in which are vested the parliamentary government of the country. The first consists of a hundred and forty-five members chosen every three years in the ratio of one for every twenty thousand of the population, the election being direct, with the right of participation by all citizens who have attained the age of twenty years. The second is composed of forty-four members, two from each Canton irrespective of its size, the mode of their election and the term of their membership being left exclusively to the respective Cantons. Clergymen are disqualified as candidates, though they are eligible for election to the Federal Assembly. The chief executive authority is deputed to a Federal Council (*Bundesrath*) of seven members, elected for three years by the Federal Assembly, and who during their term of service can not hold any other office in the Confederation or cantons, or engage in any calling or business. The President and the Vice-President of the Federal Council are the first magistrates of the Confederation. Both are elected by the Federal Assembly for the term of one year and are not eligible for the same office until after the expiration of another year. The salary of the President is three thousand dollars per annum. His prerogatives are very limited. He has no rank in the army, no power of veto, or independently to name any officials. He can not enforce a policy, declare war, make peace, or conclude a treaty, and the name of their President for any one year is even said not to be familiar to the mass of the Swiss people.

The Constitution of 1874 declares, that the Confederation has for its object to insure the independence of the country against foreign control, to preserve the tranquillity and the rights of the cantons, and to increase their common well-being. The Confederation has alone the right to declare war and conclude peace, as well as make alliances and treaties with foreign states, especially commercial treaties. But the cantons reserve the right of negotiating with foreign states any treaty affecting general administration, local intercourse, and police, so long as such treaties contain nothing injurious to the Confederation or to the rights of other cantons. The Confederation may not support a standing army, but every male citizen between twenty-four and forty-four years of age is bound to military service and drill. Those between the ages of twenty-four and thirty-two are designated as the regu-

lar army, and number—officers and men—about a hundred and twenty-five thousand; those between the ages of thirty-two and forty-four constitute the Landwehr (militia), and number about eighty-four thousand. Thus, while no great army seems to exist in Switzerland, the whole able-bodied male population of the country can readily be made into an army. The natural defenses of the country have been utilized to the best advantage, and great care has been expended upon numerous defensive works on the frontiers. No Canton may have more than three hundred men under arms. If disputes arise between Cantons they shall abstain from all recourse to violence or arms, and shall submit themselves to the decision taken upon these disputes in conformity with federal regulations. That is to say, in case of necessity the Federal Council summons the Assembly to act; or it may demand the aid of other Cantons, which are bound to give it, or it is authorized to raise troops and employ them on condition of immediately summoning the Cantonal Councils if the number of troops raised should exceed two thousand, or if they remain under arms more than three weeks.

Other articles of the Constitution regulate the military training and employment of citizens; the power of the Federal authorities in regard to public works; the maintenance of free, compulsory, and non-sectarian education; the principles of taxation and cantonal tariffs, consistently with general free trade; the right of domicile; municipal and communal rights, and the general toleration of religious belief and worship. Nevertheless, the Order of Jesuits and the societies affiliated therewith may not be admitted into any part of Switzerland; and all intervention by their members in the church or in the schools is forbidden. "The exercises of the Salvation Army fell under the laws of the municipalities against nuisances; the final judicial decision in this case being in effect that while persons of every religious belief are free to worship in Switzerland, none in so doing are free seriously to annoy their neighbors." * Freedom of the press, of local trial, and trial by jury are also guaranteed. Previous to 1848 the different Cantons conducted their postal service by different methods; but since that time its control and management, together with that of the railway system of the country, have become exclusive functions of the Federal Government.

Attention is next asked to the Cantonal political organization and government. Every Canton and demi-Canton is sovereign and independent in local affairs and in all other matters that are not limited by the Federal Constitution. In respect to their forms

* J. B. Sullivan. The Commonwealth of Switzerland.

of government, they agree in little else than the claim and possession of absolute popular sovereignty; and differ much in respect to governmental organizations and methods of administration. Twenty-two of the twenty-five Cantons (States) are divided into 2,706 communes (townships); and each commune governs itself in respect to all local affairs, so far as is consistent with cantonal and Federal rights. "The citizens of each commune regard it as their smaller state, and are jealous of any interference by the greater state; and unless the interests of the Canton or the Confederation are manifestly superior to those of the locality, the commune is unwilling to part with its administrative power and jurisdiction over its lands, forests, police, roads, schools, churches, or taxes. In the Cantons in which German is the official language (sixteen in number) it is customary for the adult male population to meet annually in an open-air assembly in a town market-place or on a mountain side, and there propose, debate, and enact their laws, and elect their officers by universal vote; thus deferring to and establishing popular will without resort to any intermediate representative machinery."

The question here naturally arises, How did such a nation or confederation, made up of twenty-two small states differing from each other in many essential features—religious, political, social, industrial, physical, and linguistic—originate? A general answer, based on a large amount of historical research and publications, is that it was due originally to a drawing to a common center of a number of small districts, from the contiguous monarchies of Germany, France, and Italy, for common defense against a common foe; and hence also it is not surprising that the political boundaries of Switzerland do not follow the natural configuration of the country.

The revenues of the Confederation or Federal Government of Switzerland in 1894 were estimated at 84,047,312 francs ($17,000,-000), and its expenditures at 83,675,000 francs. The various Cantons of Switzerland have their own budgets of revenue and expenditure. For 1895 their combined budgets indicated a revenue of about 78,880,000 francs ($15,600,000) and an expenditure somewhat greater, making a nominal aggregate of about $33,000,000 to be annually raised by some form of popular contribution or taxation. As a considerable part of the cantonal revenues is derived from the proceeds of taxes imposed and collected by the Federal Government, and as contributions are made in turn to the latter by the Cantons, it is not easy to estimate the present annual average *per-capita* burden of taxation on the people of Switzerland; but, making all allowances, it is certainly not inconsiderable. Some years since the average tax burden on every inhabitant of the

Canton of Zurich, the most populous and richest of the Swiss Cantons, was reported at 40·15 francs ($8).*

A further question of interest and importance that now arises (and which constitutes the main subject for consideration in the present chapter of this series) is, Under what system and by what methods is this certainly large average *per-capita* obligation for the maintenance of the several governments of Switzerland apportioned and collected? And as a help to a proper understanding of this problem the foregoing somewhat detailed description of the nature and functions of these governments has been thought necessary.

For the Confederation or Federal Government of Switzerland, which is not allowed to levy direct taxes, the main source of revenue is the customs (duties) on imports, which are levied and collected on the frontiers of the republic. Originally the idea on which it was sought to base the Swiss customs, was to tax all articles of commerce entering from foreign countries on a single uniform plan, having regard solely to financial and not to prohibitive or protective results; and this same idea prevails at the present time. "Changes in the customs have been made in recent years to correspond to new conditions or new commercial relations, but the Government has always kept as near free trade as good financiering would allow. The system of assessment of duties on imports differs from that of England, in that instead of a few articles being selected to stand as much duty as they will bear, a large number—almost every commodity in fact—is taxed a little. The schedule of rates contains over eight hundred articles which are subject to import duty." †

As a rule, raw materials necessary for manufactures are admitted free of duty, and while the principle of imposing the highest duties on luxuries is fully recognized, the duties on articles of general consumption are very light; tobacco paying from two to four cents per pound, tea about four cents, coffee one cent. Export duties are levied upon a very few articles, chiefly on timber, live stock, and certain raw materials. As recently as 1848 each Canton imposed cantonal tariff duties on imported goods, but these have now been abolished with one curious exception, namely, that of salt. The sale of this article being a monopoly of the state, whether its production be domestic or foreign, but its retail price being regulated by each Canton for itself, the supervision of the imports of salt into each Canton becomes necessary.

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* The present aggregate of all forms of taxation imposed for defraying all the expenditures of the Federal Government of the United States is equivalent to an average of about $6·538 per head of all its population.

† Vincent on the Government of Switzerland.

By a statute passed in 1887 the manufacture of alcoholic liquors was made a state monopoly. The net proceeds of the business as thus conducted are considerable, but the entire net receipts are distributed among the several Cantons in proportion to their population. Smuggling and other evasions of the law under the new system are acknowledged to be extensive and irrepressible, so that the measure in question is yet generally regarded in the light of an experiment.

As this subject is one of special interest in other countries, it is thought expedient in this connection to submit a presentation and review of it as recently made by Prof. John Martin Vincent, Professor of History in Johns Hopkins University, and published in a book entitled State and Federal Government in Switzerland, 1894:

"The right to manufacture the higher grades of distilled spirits belongs exclusively to the Federal Government of Switzerland. This is effected by contract either with home or foreign distillers, but at least one fourth of the quantity required must be manufactured by domestic companies to whom the Government makes allotments from time to time. In order to encourage agriculture, the distillation of certain native fruits and roots is exempted from the monopoly and made free to any one. The Government is also the distributer of liquors in quantities not less than one hundred and fifty litres (a litre = 1·05 quart), and fixes the prices. Spirits used for technical and household purposes must be sold at cost of manufacture, and before delivery must be reduced by the addition of wood spirits or other mixtures which render them unfit for drinking. The peddling of liquor from house to house is entirely forbidden except for the kind last mentioned. Retail dealers require a license from the cantonal authorities, and pay a graduated tax according to the amount of their sales. The traffic in quantities above forty litres is considered wholesale and under no restriction. The administration of the liquor business is therefore entirely in the hands of the Federal authorities until the spirits reach the retail dealers; there the Cantons step in to regulate the number and the character of the dramshops, to make the necessary sumptuary and police laws, and exact such license fees as may seem best. The net profits of the government management are collected by the Federal authorities, but divided entirely among the Cantons in proportion to population. The Cantons on their part are obliged to expend at least ten per cent of this dividend in suppressing the evils of intemperance, and to report annually to the Federal Government. Distilleries, in order to continue operations, must be large enough to supply one hundred and fifty hectolitres (a hectolitre = 26.4 gallons) a year. The monopoly is protected from competition by foreign countries by

a duty of eighty francs per hectolitre upon all high-grade liquors imported, and by a graduated scale of duties upon all containing less than seventy-two per cent of alcohol. No one except the Federal Government is permitted to import alcohol for industrial purposes, because the reducing process must undergo inspection in order to prevent fraud. In getting its supply for the home market the Government may purchase three fourths of the demand for all kinds of spirits anywhere it chooses. The other fourth, as mentioned above, must be of home manufacture, and the Government has not exceeded that limit, because spirits can be bought cheaper abroad than at home."

The financial operations of this branch of administration in 1891 amounted to about 13,660,000 francs, from which the net revenue was 5,830,000 francs ($1,165,000). "This net gain was chiefly due to the mercantile profit on liquors for drinking purposes, since industrial spirits must be sold at cost. Hence, as a business enterprise, the monopoly is certainly a success. When we inquire into the moral and social results, there is at present less that is tangible to be observed. The expectation of the promoters of the scheme was that the evils of drunkenness would be reduced, both by decreasing consumption and providing a purer quality of drink. This latter end is obtained by Government inspection, not only of the monopoly distilleries, but also of the smaller establishments manufacturing free products."

"In the matter of consumption there would seem to have been a decrease. In 1885, before the introduction of the monopoly, the total demand of distilled liquors for drinking purposes was about 150,000 hectolitres, while in 1889 the amount sold by the Federal Government for such use was 67,242 hectolitres. But it would not be safe to say that the country had become temperate to this extent, for there is strong reason to believe that much of the reduced alcohol intended for the arts is either purified again and used for drinking, or consumed outright in its mixed state. The use of liquor will by no means be brought under control so long as the distillation of low grades of fruit spirits and the manufacture of malt drinks are under no restriction. No one can tell whether the apparent decrease in consumption is not merely a diversion of appetite to applejack and absinthe, or perhaps to an increased use of wine and beer."

Small amounts to the credit of the Federal revenue also accrue from the postal and telegraph service, from the lease of public domains, the monopoly of the manufacture and sale of gunpowder, from military exemptions, and the like; but the aggregate income from these sources is comparatively unimportant. The powder monopoly at one time yielded considerable revenue, but when new and more powerful explosives came into favor the

profits were greatly impaired. The income from the Federal domains amounts to about five tenths per cent of the total revenue. The largest item of expense to the Confederation is the army, which requires nearly forty per cent of its entire revenue. "Although carrying on no wars of its own nor joining in the conquests of other countries, Switzerland is compelled to undergo this great expense in order to preserve her neutrality and the integrity of her borders."

The comparatively recent tax experience of the twenty-two Cantons of Switzerland has been very peculiar, and different in many respects from that of any other country—a result that might naturally have been expected from their respective governmental independence, jealousy of other cantons, internal antagonisms consequent on the division of each canton into sub-governing *communes,* and in the radical differences in respect both to language and religion.

The taxation of property in general (or the so-called *general property tax*) has been thoroughly tried in Switzerland and, although substantially abandoned in all other European countries, is still adhered to, and constitutes an important feature in the fiscal system of all the Swiss Cantons. In the case of realty the tax is levied on the *capital,* and not upon the annual value of the estate. In the case of personal property everything is taxed, whether it yields an income or not—furniture, pictures, jewelry, carriages, etc.; but furniture and trade appliances up to the value of $1,000 are exempted.

With a view to the successful enforcement of this kind of taxation almost every conceivable method has been devised and adopted, such as self-assessment in the form of compulsory returns on the part of the individual; assessments by officials on assumed data, oaths and no oaths, publicity and secrecy; and all of these, as has been the experience of the United States in the same line of policy, have been confessedly ineffective. One institution, however, has been developed in recent years that is peculiar to Switzerland, and that is the so-called inventory method (*inventarization*). "As soon as a taxpayer dies his entire property is at once seized by the Government and held until an exact inventory is made of it. If this discloses fraud in the previous self-assessments, punitive taxes must be paid, ranging in some cantons over a period of ten years." That such a method of tax administration has and will prove effective in increasing tax receipts can not be doubted, but its objectionable features are no less evident. Thus it intrudes upon the privacy of families, for the purpose of fixing seals upon their property, at a most inopportune moment, and seeks evidence of the violation of law, "as it were, in the very chamber of death." It also offers a bounty

for the effective transfer of property by its owner in anticipation of death.*

Considering that a greater equality of fortune prevails in Switzerland than in almost any other country, it is somewhat remarkable that it has taken lead of all countries in instituting a system of *progressive* or *graduated* taxation, and has made it applicable not only to property but also to income and inheritance taxes.

Graduated taxation now exists in a majority of the Swiss cantons, and in only a few is there any prescribed limit to the progressive rate of assessment. The graduation is applied in different ways. In some Cantons, estates (real and personal) are classified according to their amounts. The rate of the tax is the same, but a varying proportion of the value of the estate is exempted. Thus, in the Canton of Zurich the tax is levied on five tenths of a property valued at four thousand dollars, six tenths on six thousand dollars, seven tenths on ten thousand dollars, eight tenths on twenty thousand dollars, nine tenths on forty thousand dollars, and on the entire estate when exceeding forty thousand dollars in value. In other Cantons, as Aargau and Schaffhausen, an addition of varying percentage is made to the property tax according as the tax at the normal or ordinary rate exceeds a certain specified amount. Thus, in the former Canton, every one who is assessed for a tax of from forty to seventy francs in amount must pay five per cent additional; from seventy to one hundred francs, ten per cent additional, and so on, until those who are assessed at over five hundred francs pay thirty-three per cent additional. In the latter Canton every one assessed at over five hundred francs pays fifty per cent additional. In other words, the tax is graded and made progressive by adding a certain percentage, not to the taxable property, but to the amount of the tax according to a proportional ratio.

In some of the Cantons, as Vaud, Basel, and Zug, real property is divided into three classes: (*a*) under five thousand dollars, (*b*) five thousand to twenty thousand dollars, (*c*) twenty thousand dollars and upward, and a land tax which is enacted each year falls on these three classes in the proportions of 1, 1½, and 2.

In some of the Cantons personal estate is divided into seven classes and taxed in the proportions of 1, 1½, 2, 2½, 3, 3½, 4; the tax being levied on the capital and not on the annual value of the estate. In most of the Swiss Cantons the progressive or graduated system of taxation in respect to property is also made applicable to incomes, inheritances, and bequests; and as a rule the progressive scale in these respects is more sharply graduated

* Essays on Taxation, Prof. E. R. A. Seligman, p. 387.

than in the case of property taxation. "Another peculiar feature of the Swiss taxes is that the progressive rate is applied separately to the income tax and the property tax. A taxpayer with twenty-five hundred francs income from property and twenty-five hundred francs from labor will be assessed separately for each, and will pay less than if he had five thousand francs income either from property alone or labor alone." (Seligman.)

There is, furthermore, no pretense of uniformity in the different Cantons in the practical application of the progressive system. In fact, it is stated that in no two Cantons are the rates of tax and the classification of the subjects of taxation identical. In the taxation of incomes the average rate does not generally exceed four or five per cent; but in some Cantons the rates rule as high as seven and even ten per cent. Where income exists without a corresponding capital, as from wages, earnings, and life annuities, an exemption is generally made of eighty dollars a head for each person dependent on the head of the family for support. Thus a bachelor earning one thousand dollars a year would pay about fifteen dollars, while a married man with the same income and twelve children would pay nothing.

Taxes on inheritances and successions in Switzerland—which are levied in most or all of the Cantons—are characterized by extreme variations on rates, ranging from a very small percentage in some cantons to twenty and even thirty per cent in others, in the cases of the remote, or non-relatives.

Apart from the federal and cantonal systems of taxation in Switzerland, there is a third system which is regarded as distinctive, and under the name of *local* embraces special and separate assessments for the purpose of defraying local or communal expenditures—i. e., police, preservation of forests, roads, schools, and the like. A leading characteristic of such taxes is, that they do not embrace the idea of progressive or graduated assessments; and in their chief incidence on local tangible property do not permit any material reduction of appraisements, or valuations on account of any incumbent indebtedness—mortgages and the like—as is the practice in the appraisements of like property for cantonal taxation. A household tax and a poll tax are also, to some extent, features of Swiss local taxation.

Of the varied subjects of taxation from which the Swiss Cantons mainly derive their revenue, the following classification and exhibit of those of the Canton of Vaud in 1887, the third largest canton in respect to population, though not in area, will serve as an illustration:

1. Public lands, forests, and salt monopoly.
2. Licenses to retail tobacco, wine, and spirits.
3. Taxes on dogs, saddle horses, carriages, and billiard saloons.

4. A tax on all transfers of real property (*droit de mutation*).

5. An annual tax on the capital value of real property (*impôt foncier*).

6. An annual tax on the capital of all personal property and on incomes (*impôt mobilier*).

The last three taxes are the most important and productive, their united product being equal to about nine tenths of the entire revenue.

Concerning the results of this novel and complicated system of taxation in Switzerland there is great diversity of opinion. That it is not uniform throughout the comparatively small territorial divisions of the country to which it has been made applicable, only a very few Cantons being reported as in agreement; that no fixed rules governing progression or gradation in assessments have been generally agreed upon and established; that the practical administration of the system is in the highest degree arbitrary; and that the ascertainment of the tax that an individual or estate shall pay often involves a series of complex and difficult computations and additions, are all points in respect to which there is no question.

The anomaly and gross inequity of double taxation on one and the same property, contingent on the circumstance that the *situs* of the property and the domicile of its owner are not within the same territorial and governmental jurisdictions, and which is at present a subject of much discussion and deprecation in the United States, is also a vexing problem in the system of taxation in Switzerland; two different communes, as a rule, making demands of a taxpayer by reason of his holding a landed estate in one and residing and exercising the rights of a citizen in the other, and the probability of any just and satisfactory solution of this perplexing problem is as remote in one country as in the other.

Notwithstanding the above and other objectionable features, the people of Switzerland appear to be generally satisfied with their fiscal experiment, and thus far have exhibited but little disposition to change it; and all the most important Cantons that have tested it report a steady increase in their aggregate valuation of both property and income. Even the extreme high rates of taxation assessed on large properties and incomes—amounting in some Cantons almost to confiscation—have not been generally regarded with disfavor, but probably for the reason that the number of persons in Switzerland who are liable to such assessments is comparatively limited.

On the other hand, it is contended that any fiscal gain that is reported under the new system has been more than counterbalanced by depreciation in land values and injury to local trade. In

the Canton of Vaud, for example, where the new ideas are specially exemplified, wealthy families are reported as having left the Canton, and that many of its citizens regularly close their houses for nine months in the year in order to evade the law. Foreigners, too, are said to be less and less anxious to reside in the canton. In consequence of this, it is claimed that many properties in Vaud have depreciated fifty per cent, and that trade suffers greatly. Whether all these allegations are true or not, it is significant that a proposal to introduce the Vaud system into the Canton of Berne was rejected by its people by an overwhelming majority.

ADDENDUM.—Readers of the chapter on the Tax Experiences of India, in the preceding number of the Popular Science Monthly, have written to ask if there is any explanation of the remarkable difference in opinion respecting the material condition of the people of India, recently expressed in the British House of Commons (and quoted) by two of its members, Mr. J. S. Keay and Sir Richard Temple, both ex-officials of long service in the Government of India, and having had large opportunities for becoming acquainted with the country.

The explanation is probably to be found in the old story of the two knights who differed and quarreled about the mottoes on a suspended shield, by reason of exclusively viewing it from opposite sides. India is a vast country, about half as large in land area (square miles) as the United States, exclusive of Alaska, and with a population of 287,000,000, so widely separated by caste, language, and religions, that districts and villages that have been in close contiguity for long periods practically do not know or have intercourse with each other. In those portions of the country where the inhabitants are fairly intelligent, have learned to avail themselves of modern methods of agriculture, and have irrigation and transportation facilities, the production of foods and other commodities is so far in excess of any domestic demand, as to admit of such a large and constant export of grain stuffs as to threaten disturbance to the markets of Europe and the United States, besides textiles, fibers, dyestuffs, opium, oils and oil seeds, hardware, sugar, etc. In other districts of large population where the people still plow with crooked sticks, do not even recognize the value of manures or other fertilizers, are almost entirely lacking in facilities for transportation, and are so bound down by caste that it is difficult to induce them to emigrate to districts—like the Assam tea producing sections—where labor is in good demand at comparatively high wages—in such districts the increase of population so presses on its ordinary food supplies that, in case of any deficiency in the average crops, famine always ensues, and

is only mitigated by the aid that comes through the extraordinary pension fund extablished and distributed by the British Colonial government. The Duke of Argyll, who has been Secretary of State for India, tells us that "those only who have had any share in the government of India can know what the anxiety is arising out of such conditions of population"; and extensive emigration is now advocated as the best remedial action that can be taken. Making allowance for different standpoints of observation, Mr. Keay and Sir Richard Temple were, therefore, both right in their conclusions. D. A. W.

To the Reader: With the publication of the chapter in this number of the Popular Science Monthly on "The Tax Experiences of Switzerland," the first part of the plan laid out by the writer for discussing the Principles of Taxation comes to a conclusion. This plan, apart from an introductory survey of the subject, and a review of the interesting and most instructive tax experiences of the United States consequent on the civil war, and with which the writer (as chairman of the United States Revenue Commission in 1865, and as United States Special Commissioner of Revenue from 1866 to 1870), was officially and closely associated (Chapters I and II), was to set forth the position of taxation in literature and history; and more especially to narrate the most notable experiences of different countries and nations in compelling contributions or exactions for the support of the state from the people governed, and the far-reaching and important results that have been contingent upon and have followed the different policies that have been adopted for such a purpose. The underlying idea that suggested this plan was as follows:

Every person of ordinary intelligence, if questioned, will probably admit that the subject of taxation is one of the most important that can concern the masses of the people; and that their well-being and the continuance of good government, and even of civilization itself, are more dependent on the involved power of its administration and discretionary incidence than upon any other agency—a power so great that its right exercise in even the smallest degree, according to the late Chief-Justice Marshall, "involves the right to destroy." And yet the same citizen will probably say that the subject, as ordinarily presented and discussed, is so dry and uninteresting as to be exceedingly unattractive, and even repellent; that the conflict of opinion on the part of those who through study claim to understand it is so diverse that any general concurrence of opinion in regard to fundamental principles is impossible; and, finally, that all experience shows that by reason of this state of things mercenary and political considerations necessarily predominate in the construction of any general system of taxation.

It is obvious that under such circumstances it must be difficult or impossible to induce the masses of the people to intelligently interest themselves in the subject of taxation, and that in countries like the United States, where under free and universal suffrage the same people elect the legislators who shall determine the policy of their Government, laws will be enacted for the collection of revenue for the support of the state that will be neither productive or effective, and do not promote, but rather impair the industrial and commercial interests of the country.

The question, then, next suggests itself, How can a different state of things be brought about? How can the people in general be induced, in the sense of persuasion and not of compulsion, to interest themselves in this subject? The idea of the writer is that such a change can best be effected by showing that the subject is not necessarily dry and uninteresting; that it really constitutes more than almost any other element the essence of history; and that the record of the results that have followed the attempts to establish almost every form of taxation that human ingenuity can devise, has even in a very high degree the attraction of romance. Its study from such a point of view constitutes a better basis for casting a horoscope of the future of nations and governments than aught else within the ken of the historical student.

In the foregoing chapters the writer has attempted to carry out this idea. That it has been in at least a degree successful is demonstrated by the great number of commendatory letters that have come to him from different countries—even China—and from people of most varied interests, situations, and occupations.

In the chapters that are to follow, where a search for the underlying principles of taxation is to be prosecuted, a resort to more or less abstract reasoning is a necessity. But even here the presentation of abstract principles, to which assent will be asked or expected, will be avoided as far as possible, with the expectation that the reader will, from a consideration of the facts and deductions presented, be able himself to frame and determine the principles that should govern a correct system of taxation by a process of self-evident induction.

An interesting illustration of the interdependence of organisms, and of the existence of close relations where no relations are suspected, is pointed out by Miss Ormerod. Water-cress farmers are greatly annoyed and often have to suffer considerable destruction of their crops by the depredations of the larvæ of caddis flies. These larvæ are delicious morsels for trout, and where trout abound they are scarce and the cresses flourish. But if heron abound, they destroy the trout, the caddis flies are not eaten up, and the cresses are.

THE STONE FOREST OF FLORISSANT.

By Prof. ANGELO HEILPRIN.

TO the many who annually wander forth in quest of a "change of scene," and have not yet fully exhausted the wonders of Nature in their search after the purely beautiful, any locality that offers material for special wonderment comes with pleasing interest. One such, which is less generally known than other localities of a somewhat similar character in the United States—indeed, is hardly known beyond the pale of a limited coterie of geologists—is the region of ranch and meadow land which lies within a mile and a half of the line of the Colorado Midland Railroad near to the station of Florissant. In reaching it we have crossed the front or outer range of the Rocky Mountains, traversed

The Giant Stone Forester of Florissant, Colorado.

the charming flower gardens of Summit Park at an elevation of nearly nine thousand feet, and have again descended to eight thousand one hundred feet. A gently undulating plain of meadow-land is in the main occupied by Costello's and Halthusen's ranches, and around and about sweep up the chain of heights which help to make up the great backbone of the North American continent. There is little to suggest in this landscape that we are in the heart of the Rockies; the rugged crags to which the mind has affectionately attached itself from childhood's study are hidden beneath a dense covering of piny woodland, or else wander off much in the manner of the Eastern Appalachians. Here and there in the not

very distant horizon a peak looms up with special prominence, and occasional patches of snow indicate that the mountain crests lie well above the thirteen thousand and fourteen thousand foot line, for below that line, and generally even above it, the lingering winter snows rapidly depart before the summer's heat. The two thousand feet advantage that we possess in the elevation of this region over that of Mount Washington is in no way indicated by the thermometer; an almost subtropical sunshine warms up the open expanse of the Rocky Mountain parks, and with it there are but few reminders of the chilly blasts that habitually sweep over the crests of the White Hills.

Florissant has long been famous with geologists for the wealth of insect remains which its rocks harbor. No other locality of the earth's surface, not even the famous Oeningen beds of Switzerland, has disclosed an insect fauna of equal variety and abundance, or with characters so well preserved as they are here. From butterfly to beetle, wasp, dragon-fly, and ant, almost every type of this great group of animals belonging to the period of the making of the Florissant rock is represented in the soft and thinly bedded shales which here and there force themselves through the not over-luxuriant covering of sward. If, perhaps, the better specimens have by this time been culled by the ever-grasping geological collector, many yet remain, and with rapture the eye follows the marks of hair and exquisite venation which have withstood a time action of perhaps one hundred thousand to two hundred thousand years.

My own purpose in visiting the Florissant Basin during the past summer was less for the study of its extinct animal remains than for inspecting the *débris* of the wonderful forest which ages ago had undergone its transmutation into stone, and now reads its own history from monuments which are destined to live for equal ages in the future. With me were a number of students, of both sexes, who had determined to share the pleasures and discomforts of camp travel, from cañon to mountain peak, and to whom the quasi-luxuriance of the big Rocky Mountain coach was in no way an obstacle. A few hours' easy journey across the Hayden Divide brought us from our quarters at Green Mountain Falls, on the northern shoulder of Pike's Peak, to the land of ancient lake and dead volcano, where, under the kindly guidance of the ranchero and his amiable daughter, we were almost immediately put in sympathetic touch with the relics of departed life.

To the geological mind the Florissant Basin is an ancient silted lake, the waters of which succumbed to that sure infiltration of sediment which marks the beginning and end of nearly all standing bodies of continental waters. In this case, however, it was not the deposition of sediment within the lake by inflowing streams

that produced the lake's annihilation, but in the main the aërial discharges of volcanoes. Even to-day the practiced eye will soon pick out from among the many mountain forms that surround this ranchland the conical contours of the volcano. A few such stand by themselves, neither of great height nor of imposing mass; others are disposed in linear series, much like the cones which so abundantly scatter themselves over the southwestern and Mexican plateaus. We ascended one of these, a conelet of perhaps one hundred and fifty feet elevation, whose partially wooded sides were yet the ancient slag and cinders, and from whose top projected the plug of lava which marked the position of the former vent. In a pit near by could be seen the hard

The Giant Stone Forester (Sequoia) of Florissant. Forty-five feet in circumference.

basalt-trachyte which forms the existing core of the mountain—the material which in early Miocene times, or perhaps still earlier, was active in the distribution of the loose rock fragments which everywhere lie scattered about. In the days of its activity the foot of the volcano bordered a still more ancient lake, or was even immersed in it, as the lacustrine deposits which largely encircle it plainly show. In these are found in scattered spots a number of fresh-water types of mollusks—*Planorbis, Physa, Limnea, Valvata, Cyclas*—their shells as beautifully preserved as the much more delicate parts of the insects which were shortly added to them.

The eruption came, and with it clouds of ash sailed upward, only to fall back into the lake waters, and with them form a sticky and lasting paste, ultimately to harden into a compact

rock. This is to-day the floor of the basin, and in it are wrapped the thousands of insects which at the time disported in the subtropical sunshine, and whose lives were involved in the catas-

A Rocky Mountain "Park," across the Florissant Basin, Colorado.

trophe. Fish remains are still occasionally met with, but they do not appear to be in any way abundant. The heated waters flooded portions of the adjacent dry land, and destroyed the stately forest that grew down to the banks—the forest of giant redwoods (*Sequoia*) which already then clothed this portion of the North American continent, and whose extension is to be found in the forest heaps of Patoot and Atanekerdlook on the western coast of Greenland, almost under the seventieth parallel of north latitude. It was a different climate then. The *Sequoias* do not, perhaps, teach us much, since they, or a closely allied species, are still a part of the vegetative product of California, and are to-day a wonder in their own land; but when they reared their majestic trunks above the plains of Florissant, they did so in association with palms and with other representatives of the southern climes. They fell together, and together have their remains been preserved.

The silicified trees of the Florissant Basin are a marked curiosity of the United States. They are less known than the "stone forest" of Arizona, or than the similar mausoleum of the Yellowstone region, but it is only because they have not yet been brought to the attention of the tourist. The trees are at the present time represented only by their stumps. In wandering over the green meadow the eye here and there rests upon a seem-

ingly "bald" spot. Over it are scattered white and yellow chips, and, for anything that the eye can itself distinguish, these could easily be the chips left in the path of work of a recently passing woodsman. The deception is absolute, and it belongs to the stump as well. The knots and gnarls and annular rings are perfectly preserved; the bark stands in prominent relief both by ruggedness and color, and all this not in wood, but in the monumental substance of stone. The precise manner in which the substitution of silica for wood was effected can not now be learned, but, in a general way, we know it to have been brought about as the result of a slow infiltration into the tree trunks of heated waters containing silica in solution.

The remains are fairly numerous, but what strikes one with special astonishment is the giant size which some of them attain. Diameters of six, seven, and eight feet are by no means uncommon, and we measured three specimens which spanned ten feet or more. In most instances the stumps hardly rise above the surface, coming up flush with it; therefore, without excavation, it is impossible to say at what height above the roots the measurements were taken. In what might be termed the "king of the forest"—the tree represented in the accompanying illustrations—a definite basis for measurement is presented, inasmuch as the tree has been laid bare to its roots. The stump stands about fifteen feet high, and at that distance above the roots it measures forty-five feet in girth—a colossus that would hardly be shamed by its more gigantic brethren of the existing redwood forests of California. This, so far as I have been able to ascertain, is the *facile princeps*

The Giant Stump. About fifteen feet elevation.

of stone foresters—a curiosity in Nature of which the world offers but few duplicates. Imbedded hard within the trunk, and held by it fast as in a vise, are the blades of two gang saws, the wreck of a barbaric effort to section the tree and remove it in parts to the World's Columbian Exposition. It is stated that this effort at desecration was only abandoned after it had involved the expenditure of some three thousand to four thousand dollars.

Near by is a stump whose surface measures eleven feet in diameter, and it may well be that excavation nearer to the roots would disclose a size fully equal to that of its more "costly" neighbor. All in all, the trees in this region are much larger than those of the "petrified forest" of Arizona, and their comparative antiquity gives them a special claim upon the attention of the geologist. In the more southerly tract they rarely attain a diameter of four or at most five feet, and more generally two and three feet give the full measure. Most of the fragments lie prostrate—an indication that there was a subversion of the forest before petrifaction set in, and it is difficult to find pieces of more than four feet continuous length. The trees, so far as botanical study has determined them, were pines, and not the more stately *Sequoias* of the north. And yet, even with such forms, a giant stature was not exactly absent, for only a short time back a prostrate shattered trunk was measured over a length of about a hundred and fifty feet. It is, by way of contrast, a little remarkable that at Florissant so many (perhaps most) of the trees still retain an upright position, a condition that suggests peaceful decay, or at least one that was not associated with any cataclysm of the land surface. In whatever way overwhelmed to death—and the falling ash would itself be quite competent to effect this—it seems not unlikely that silicification proceeded to a level prescribed by the surface of the heated waters of the lake, above which the trees fell. It would be a satisfaction, certainly, to have excavations conducted here; but whether carried out or not, the region is one that stands with its own interest, and to which the tourist can safely be recommended to carry his explorations in search of Nature's wonderland.

Some remarkable sculptures in ivory—described as being executed with marvelous art and great vigor and accuracy—have been discovered in a cave at Brassempouy, near Pau, France. They are assigned to the beginning of what the French archæologists call the Magdalenian period or the end of the Mousterian. One of them exhibits the features of prominent haunches and pendant breasts which are often seen among the Hottentots and other African tribes; another, a head, presents a Basque physiognomy, and bears a coiffure carefully arranged in parallel braids so as to resemble an ancient Egyptian headdress.

THE AIM OF MODERN EDUCATION.

By Dr. C. HANFORD HENDERSON.

IN venturing to speak or write about a topic so much spoken about and so much written about as education, one may be pardoned a little hesitation. In the midst of our present wealth of educational theories, the need seems not so much for any addition to them or any restatement of them as for a little genuine, wholesome action in carrying them into effect. And yet this problem, the education of our children, though so very old and so much discussed, is always new and never exhausted. The last word has not been spoken.

This perennial interest in education springs, I think, from two sources—from a feeling that much of the current action that goes under the name of education is obviously ill-advised, and from an appreciation of the tremendous importance of the whole matter. For, mark you, what we propose to discuss is no more nor less than this—the unfolding of the human spirit. It is a process for whose preparation the mighty drama of evolution has not been counted too great; and, now that that drama has become in our hands a conscious process, we can scarcely overestimate the unique significance of this, its concluding scene. It is an august problem, one that I stand before in reverence and humility.

In a day of more childlike faith one can readily conceive the attitude of mind of those who, in the presence of such an issue as this, devoutly waited for the working of the Spirit, and listened to its utterance as to the oracle of God. But though the old faiths are dead, or at least certain aspects of them, there is a new faith no less inspiring and no less revered. Modern faith believes in the essential sanity of the human spirit. It believes that it is possible by pure and holy living to so strengthen and clarify the spiritual vision that one may catch some glimpse of the divinely human truth. And this glimpse comes not to one man alone but to you and to me, when together, in the disinterestedness of a common purpose, we attempt to let the light play about the problems of the inner life.

And first let me say, in considering the aim of modern education, that I do not do so as the advocate of any special system or of any limited cult. I am in no sense a special pleader. It may be known to some of my readers that I have had for several years the charge of a manual training school in Philadelphia, and the thought would be quite natural that I may have come to regard the salvation of childhood as dependent in some occult way upon the training of its extremities. But, believe me, this is far from the truth. We hold, rather, the deep conviction that the province

of secondary education is to lay broad, general, catholic foundations for the successful conduct of life. We should defeat ourselves by indulging in any specialty, however commendable in itself. What we are after is culture, and the power and perfection that come through culture. It is no new motive. On the contrary, it is a very old motive, as old as the birth of the human spirit itself. But it is still the motive underlying all that new movement in education of which manual training, sloyd, and the kindergarten form so prominent a part. I believe that not all the men and women taking part in the movement would agree to such a statement of motive. Some at least among them would assign more special and technical ends. I make the statement, however, quite unreservedly. What *does* distinguish the new movement is that in the choice of methods it differs somewhat radically from the older efforts. Be kind enough, then, at the outset to distinguish between motive and method, between ends and means.

In speaking about the present demands upon the school I do not think we hit the mark when we confine ourselves to the industrial demands, or the economic demands, or the social demands, or to any other one aspect of a very complex problem. Nor do I think we get any place when we propose to offer in satisfaction of these demands any one panacea. I would stand rather upon a broader platform, and ask your sympathy and consent to a much more catholic solution.

The problem of education is forever presenting this double interrogation point: What do you want? How are you going to get it? They are very definite questions, and it is easy enough to give equally definite answers so long as one confines one's self to general terms. We want culture, and the power and perfection that come through culture. We shall get it by surrounding the child with those influences that make for culture. But when we come to translate these general terms into something more specific, and, still more, when we come to translate our words into action, it is then that the difficulty comes; it is then that the educational sun goes under a cloud. Yet, as we love education, we must go on forever asking these questions, and we must go on forever trying to answer them. What we should pray for is clearness.

One of the most difficult branches in the modern school curriculum is apparently mathematics. We are prone to grade the children by their progress in this one branch. Yet it is not essentially difficult. If you will analyze it for a moment, mathematical study is but a study of the quantitative relations of life. It is consequently axiomatic. It needs for its mastery only clear statement. Higher and lower mathematics are equally easy of com-

prehension if they are only clearly stated. It is, I think, this effort after clearness of statement that gives to mathematics its high disciplinary value. The apparent difficulty that surrounds mathematics and has made it a dreaded name to so many generations of schoolboys comes, I believe, from the way we approach the science, and is chargeable to the cloudiness of our own mental atmosphere.

Now it seems to me that we stand toward education in very much the same attitude. It is apparently the most difficult problem that presents itself in modern life. It is certainly the gravest. But here, too, the difficulty lies not so much in the problem itself as in our statement of it. If we could clearly state what we are after in education and stick very close to that, I have large faith that we should be able to get it.

We do not begin *de novo*. Others have been pegging away at the same problem. We find an educational process already in operation, and bearing unmistakable signs of its evolution. It is a process which has grown up in answer to the demands of a varied, and for the most part of a past, life. What we do in the name of education, we do because at some time the circumstances of life made it seem wise. I do not for a moment venture upon the statement that it *was* wise. Much that we do was never wise under any circumstances. But we may readily believe that each element brought into education came in response to some outward condition. Yesterday, as well as to-day, had its demands upon the school. A progressive education would be one in which the educational process was being constantly readjusted to meet these changing conditions. In a rough and somewhat rebellious way this is what does happen. But the readjustment is not easy, continuous, voluntary. It comes by irregular jumps. The old customs have considerable inertia. The mechanical workers, the men and women in whose hands the process of education mainly rests, follow the line of least resistance. And the line of least resistance is to go on in the way one has been accustomed to going on. So it comes about, quite easily and naturally, that the schools get much behind the informed spirit of the time. The process they follow is no longer in harmony with the demands of the life which it is meant to serve, is indeed very much out of harmony with those demands. The children become restless. The teachers find their work difficult. The outside world grows impatient. And now at this juncture some reform is inaugurated. It is hailed, and very sincerely, as an entirely new departure. The reformer is believed to be a radical in either motive or method. But, in point of fact, the reformer and the departure which he proposes are much less radical than they are believed to be. It is difficult to be original, and as rare as it is difficult. All the forces

at work in modern society tend to produce average men. What the reform does attempt is simply this—to bring the educational process once more into harmony with the *Zeit-Geist.* Its office is to sweep away customs and practices that were never wise, and to transform those which were founded in right reason into more modern and available form. This is all that can be done—is perhaps all that it is desirable to do. No single reform can be very sweeping, for observe, it is to operate upon a set of conditions of which it is itself a product. Hence it is that the reforms which are the most far-reaching in their results come from outside, are forced upon our institutions and enterprises by those who stand themselves outside of the movement. In our education we have precisely the same spectacle, a curious one surely, if it were not for this explanation. The movements which are to-day innovations, and which are looked upon by many of us as reforms, have such an outside origin. The kindergarten, sloyd, manual training, science lessons, and nearly all the features that distinguish the newer education, have not sprung up within the curriculum of the school. They have forced themselves into the school from without, and often after a very long struggle. These readjustments are made only at the cost of considerable opposition and heartburn. They are the efforts to bring the spirit from the past into the present. It is the attitude of mind which says, I *am,* not I *was.*

Looking at the schools in this way, you will perhaps agree with me that nothing we do in them is in itself commendable, but is only commendable as it serves some desirable end. Good and bad are relative terms. Schools are good or bad in no absolute sense, but solely in relation to the ends which they serve. Schools which were very good a quarter of a century ago might be relatively bad at the present time. Bear in mind that the school is a tool, a process, a means, is in no sense an end.

As a tool, we can judge the modern school only by the manner in which it does its work. And this makes necessary a clear understanding of the work it is to do. It is here that we need that clearness of expression of which I have been speaking. There is no end to-day of discussion on educational topics. We are all reading papers or giving little talks. We come pretty near to realizing Joubert's famous saying, "It is better to discuss a question without settling it than to settle it without discussing it." But meanwhile the schools must go on, even though the discussion come to no conclusion. This multiplicity of discussion serves at least one good purpose. It directs public attention to the gravity of the problem of education. And yet it seems to me that much of the discussion is idle, and must from its very nature continue to be so. The weakness lies in this, that it is for the most part a discussion of methods and of minor riddles. It is not

basal enough. It does not sufficiently address itself to the question of the sort of men and women we wish to produce. How to get culture will depend upon what you mean by culture. And this can not be stated once for all. It is a shifting ideal, growing as the spirit of man grows.

Perhaps we shall the sooner see our mark by first clearing the ground a little, and disclaiming some of the ends proposed for education. My own list of unadmitted ends is somewhat long. I do not, for example, set as the object for education a good citizen, a successful breadwinner, a wise father, an expert mechanic, an adroit versifier, a keen lawyer, an eloquent preacher, a skillful physician, a learned professor, a prosperous tradesman. Some of these ends may be good enough in themselves. I do not discuss the question. But they are not the proper end of education. And they are not, because they are secondary, minor, special ends. They are not the major ends in life, though they are often mistaken for such. We are pretty far from the mark when we mistake for education any training which has a partial and special end in view. To erect any one of these ends into *the* end, and declare it to be the goal of education, is to fall by the wayside, and deliberately to turn one's face away from the New Jerusalem of the Intellect.

The end in education should be the major end. It should be the very biggest thing in life, the most general and far-reaching good the mind can formulate. We cheat ourselves, we cheat the children, if we express the end in terms any less catholic than this. It may include good citizenship, wise parenthood, successful breadwinning, literary or technical skill, but it is not any one of these things. The greatest thing in life *is* life—life in its fullness and totality. It is this that education should set its face toward. Its end should be wholeness, integrity, and nothing less than this. It is false to its mission if it turn aside into any of the bypaths of convenience, of industry, or even of accomplishment and erudition. These are broad terms that I have been using and somewhat ambitious. But I can say no less than this and say what I mean. Education has to do with the whole of life, with man, and not with any one or any group of his petty activities. He must take an acceptable part in the life of effort, and to do this he must be prepared. There is a time when special technical training is advisable, when it is the proper usurper of the time; but this is quite secondary, a mere supplement to the main business of education. It is a deplorable intrusion if it ever take the place of education. There is a marked tendency in us all to get things out of perspective, to specialize, to confound magnitudes, and, of equal elements in a problem, to see one big and the other small. We are prone to mistake the means for the end.

Now turn to a more cosmic conception. For one moment let us isolate a man. Place him naked and alone in the midst of Nature, in the open sunshine. Clothe him with health and beauty. Endow him with a clear mind, a warm heart, a keen love of perfection. Make him self-poised, resolute, independent. Then bring him into relation with his fellows. Have him share in all the wholesome activities of life. Let him taste of labor and joy. Let him be a son, a brother, a friend, a lover, a husband, a father, a citizen, a worker, an idler, a thinker, an artist. Let him feel. Let him philosophize. This is to taste life in its entirety. Great God, how few of us do it! How slight we are! How partial! And what a tragedy that, in the name of education, we should go on working for fragments instead of for the completed whole! And this figure of the complete man is the figure that modern education has in mind. An impossible figure, you may say. Yet less impossible the more you and I believe in it. Such a figure is not the ideal of the economists, with their extreme division of labor and their strong belief in the economic trinity of production, distribution, and consumption, but it is a figure which appeals to those men who, like myself, believe in what I may call the scientific humanism. As I see the matter, we want to turn boys toward this ideal of full living, to make them *en rapport* with the universe and with man, to bring them out of their smaller into their larger self, to change them from a less evolved into a more evolved existence. We want to create in them a discontent with partial, secondary, minor ends. We want to turn their faces toward the major end. To do this is to magnify the human spirit —that spirit in whose essential sanity I so profoundly believe. And so I define education as the unfolding and perfecting of the human spirit.

I do not know whether my readers agree to this answer of mine as to what we want to do. I hope that they do agree to it, for to believe less would seem to me to make out life meaner and cheaper than it is. This ideal is but a restatement of the old ideal of the earnest pagan world. To see things as they are is the mission of culture. To adjust one's life to this clear perception of things is to gain the power and perfection that come through culture. But our modern complex world has not taken this motive in its simplicity. It has modified it so that now it reads: To see *some* things as they are, and notably those things which have to do with material convenience and progress. This is not life in its entirety. It is life weak on the human, emotional, artistic side, life weak on the side that can least afford to be weak. We are waking up to this fact. We are waking up to a feeling that modern school life *is* rather juiceless. On many sides I see a hopeful discontent—a discontent which is to be the prologue to that intel-

lectual and spiritual renaissance which I doubt not will grace the opening years of the coming century. This is what we want—this fullness of life. Shall we ever get it? My friends, that depends upon us—upon you and me, upon the earnestness and single-heartedness with which we want it. Assuredly we shall never get it if we continue to fix our gaze upon the partial, upon the fragment, and forget that there is such a thing as the greater whole. If you persist in saying, This is good, and That is good, and proceed to build up educational institutions for the pursuit of this and that, what you get will be simply what you pursue—this and that, and naught else. And the result of this pursuit, of this process of emphasizing one or two sides of life and ignoring many other sides of equal or even greater importance—the result is not beautiful, is not encouraging. In many cases the discipline of life at large would be more valuable. It is this feeling that makes me count myself fortunate to have gone to school but two years in all my life.

It would perhaps interest you just here to learn a bit of curious testimony in regard to the practical effect of this pursuit of the partial. It came in my own experience. Before I went to Europe to study I had charge of the science department in our older manual training school, and I noticed, or thought I noticed, that many of my brighter and more promising boys had, for some reason or other, been to school very little, less indeed than the average. The suspicion grew so strong that at last I decided to test it. I had each boy in a certain class write out his age, the number of years he had been in school, how old he was when he started, and whether the school had been public or private. There were some surprises. There were some boys who had been to school for eleven years, who had been through all the dismal grind of the primary, secondary, and grammar schools, and who were still bright and attractive. But the result of the whole scrutiny warranted the remarkable generalization that the brightness and desirability of the boys as pupils was *inversely* proportional to the number of years they had been at school. In a word, I could do more with the boys who had been least in school. Do you comprehend the full significance of this statement? I have never been able to forget it. It has made me critical of school processes and methods. It stands before me a silent specter. I cry aloud, Woe unto us if we are sending our children to school to their hurt!

Let us turn now to that second question, How shall we get what we want?

When I was quite a young man I went over to New York on a literary mission. My purpose was somewhat ill defined, but I think I had it in mind in a vague way that I could be very useful

on the staff of one of the leading periodicals, and, in view of the chaste and elegant English *then* at my command, I fear that I expected a pretty high post. Among others, I carried a letter of introduction to Mr. Roswell Smith, the editor of The Century. He received me very kindly and talked with me for some moments. Finally he said to me: "You want to write?" I said that I did. "Well," he answered, "if you want to write, write," and he held out his hand. The interview was over. As I returned to Philadelphia I could not help the reflection that I had gone a considerable distance for so obvious advice. But do you know, the more I thought over the matter the more I came to the conclusion that Mr. Smith had touched off the position with great nicety. If I wanted to write, there was just this one thing open to me to do, and that was to write. This bit of obvious advice has never quite got out of my head. But it is not a principle which often leads along the line of least resistance. On the contrary, like the Czar's railroad from Moscow to St. Petersburg, it goes in a straight line, quite regardless of mountain and morass. It asks us frequently to oppose what is of all the most difficult to oppose—the wishes and counsel of friends. If you want to do a thing, do it. This is simple advice, but it sometimes takes a hero to follow it. In this matter of education I see no other way open to us. If we want for our children life in its fullness and totality and beauty, we must address ourselves to the task of realizing this, and be contented with no partial solution. It is not an easy task.

Life in its totality—this means twenty-four hours, seven days, four weeks, twelve months, threescore years and ten; it means feeling, thinking, acting; it means the life of the organism—birth, nutrition, growth, reproduction, death; it means the life of the emotions; it means the life of the intellect—acquisition, reflection, creation. It means nothing less than this; and the moral measure of our work as teachers will be the measure of the fullness of life that we open to our children. Were we tried by this standard to-day, I dread to reflect how many of us would be found wanting!

And yet I have said that this gigantic problem, like mathematics, is only difficult in appearance; is in reality quite simple. I believe this to be true, provided, observe, that we can attain a clear statement of the problem, and maintain this clearness in all our dealing with it. And we gain clearness and rationality, the stronger our hold upon the principle of causation. If we really believe in cause and effect and in the necessary relation between them, we will realize that we can never gain complete effects by setting in operation partial causes. This is, indeed, the great lesson in method that we all have to learn. With a clear idea of the

end, we must set going adequate means. The machinery must be competent to do the work. Here it is that the older methods have been found wanting. They do not provide for life in its totality. The answer may well be made that they were never meant to. They attempted to deal only with one side of life—the intellectual. The other side, the emotional, bodily life, was left to the home. This division would not be amiss, if it were possible to so divide the child, and if both school and home were equipped to do their share of the work and received each its due share of the child's time. But this is not the case, and, from the very nature of our being, *can not* be the case. The child is *not* divisible. It is a unit, a *monistic* child. The intellectual life depends for its material upon the bodily sensations, and for its motive and coloring upon the emotions. Separate these, and the result is a crippling of the whole process of education. Separate them very far, and the result is fatal. The emotions are the inner springs of action, and upon the healthy life of the emotions depend the joy and fullness of action. The poets have long known this. It has been the burden of their singing. When we love, then are we strong. It has been with them a divine intuition. It might have been a direct induction, for it is not only the teaching of the poets, but it is the teaching of life. The history of all action is the history of expressed emotion. Every conflict on the world's arena has been the drama of conflicting feeling. Stint emotion, stifle feeling, and there comes the most dreadful of all the soul's maladies—that fatal apathy which makes action impossible and life a stupid slumbering. And when action is gone, when experience is curtailed, when sensations are limited, intellection becomes feeble, for it has no stuff to work upon. Believe me, the most terrible paralysis that can befall the human spirit is the paralysis of feeling, the slow drying up of the emotions. It is this that makes old age a tragedy and life a bitter, juiceless thing. I would that we, who presume to teach children—for it is a presumption—I would that we might early learn this lesson. It would transform us into teachers of men. It is a truth beautiful in its operation when we realize it and act upon it, terrible in its operation when we lose sight of it and deny it. And this same great truth, hit upon by poets and thinkers as they wandered over the open fields or in the deep forests, under the hush of the night or in the broad sunshine, is precisely the truth hit upon by colder methods in the laboratory of the psychologist. We have been discrediting "mere feeling," and asking for something more solid and enduring. It is much as if we scorned the springs and brooks and still asked for broad rivers to float our argosies upon. The emotions are the elements out of which is built the whole life drama. They are the *first* terms in the *syn-*

thesis of life, the stuff out of which each earnest, loving soul builds his world. Likewise, they are the *last* terms in the *analysis* of life, the ultimates reached by the painstaking, fact-loving man of science.

Pardon my too persistent iteration. But I am saying this over and over again, hoping to so say it at last that it will seize upon your imagination and carry us both into a new and more rational comprehension of the problem of education. The child is a *unit*, and neither he nor you can separate his intellectual from his emotional, bodily life. It might be desirable, it would certainly be convenient, if we could present great slices of truth, like a generous help of layer cake, to the minds of our children, and have it thoroughly assimilated by methods prescribed by ourselves in normal schools assembled. But however desirable or convenient, it is not possible. Yet we go on trying—yesterday, to-day—I hope not forever. To do this is to deny causation and invoke the power of magic and the black arts. There is but one avenue of approach to the mind of a child. It is the avenue pointed out in earlier days by loving intuition—that unconscious induction of the untaught spirit—and in later days by the colder scrutiny of science—that conscious induction of the informed spirit. It is the approach to action through feeling, and to thought through sensation. The causal chain is very distinct. It should be well noted: feeling, action, sensation, thought. You see, then, how psychologically impossible it is to reach the last link in this chain without passing through the intermediate links. Yet this is precisely what we attempt to do when we divorce the thought life from the bodily life, and assign the one to the school and the other to the home.

If it were equally agreeable to sit still as to walk, and we happened to be sitting still, we should go on sitting still all the rest of our lives. The balance of pleasure and pain being equal, there would be no motive to action. The absence of desire would be the absence of power. We should be as hopelessly bound to our chair as Prometheus to his rock. In this condition we might be picked up, might even through the application of some external force be made to go through the motion of walking, but it would be an awkward, ungracious act. A better way to get us to walk would be to offer some inducement—in a word, to enlist desire on the side of walking. The internal force is infinitely more efficient than the external. No one can make us walk so well as we can walk ourselves, for walking, after all, is a mental act. No action, however simple or complex, can be brought about without an appeal to the spring of action, and the spring of all action is a feeling, a desire, an emotion. It is perfectly hopeless to ask your apathetic subject, sitting there in the chair, to get up and walk,

unless you offer at the same time some sufficient reason for walking; and observe, please, the reason must be one that appeals to *him* and not alone to *you*. It is *his* desire, not *yours*, that is going to make him stir himself. Is it not the same with a child and his lessons? It is quite as hopeless to ask a child to learn unless you first see to it that he wants to learn. You may force him to go through the motion of learning, just as it was possible to force the apathetic man to go through the motion of walking, may even force the child to memorize the lesson and recite it with verbal accuracy, but it will be an awkward, ungracious act, and will do the child injury rather than good. And the injury is of a very positive kind. It drives another nail into the coffin of desire. By so much is the emotional life of the child dead and are his intellectual possibilities stunted. I am not speaking with picturesque exaggeration when I tell you that in many a schoolroom where this process of drilling children is being carried out, I experience a distinct sensation of spiritual horror, a sense of intense darkness, for I say to myself: Here is accomplished the death of the spirit; here are children growing each day more listless and apathetic, not learning what we want them to learn, and losing in the vain effort what no one can afford to lose—the joyous life of childhood, rich in strong feeling and high spirit, in itself an end of beauty, and a source of perfect manhood and womanhood. In all sincerity, it seems to me an evil greater by far than the evil committed by acknowledged thieves. It is a spiritual robbery, the least endurable of all robberies. I have been often robbed. I have been "held up" in Montana, and robbed by less direct methods in other parts of the world. You have doubtless had similar experiences. But these losses sink into absolute insignificance in comparison with the more dreadful losses inflicted by poor teachers and guides. You have doubtless had similar experiences. The reflection may be made without bitterness, but it ought not to be made without bearing fruit of the most wholesome sort in our own handling of that delicate bit of organism—the mind of a child.

What we must do, then, in educating children is first and foremost to give full and free play to the emotional life. We want consciously and deliberately to encourage feeling and sentiment, and to create the greatest possible number of wholesome desires. This may sound to you like strange doctrine. It will, however, bear your examination. It is easy to cultivate the emotional life in children. All we have to do is not to suppress it. And yet even this negative function, this clearing of the ground, requires *finesse* on our part. What we want in children is totally unconscious sentiment. Children who are well, children in whom the pulse of life beats high and quick, are reservoirs of feeling, bits

of concrete sentiment, bundles of desire. In the majority of our schools we try to crush this all out. What we should do is to encourage it. If we are sympathetic, if we are responsive, if we are wise, we will hesitate to check this flood of feeling. It is to be disciplined, but not destroyed. It is the same with the multiform desires of childhood. Many of them can not be gratified, but the child-life will be fuller and more wholesome if they are allowed as far as may be. And I so value this emotional life, this prodigality of sentiment and desire, because it all leads to action, and to the very sort of action that is educationally the most valuable —to that which is self-prompted. Froebel hit upon this in the kindergarten, and made self-activity the corner stone of his whole system. He could not have built truer. It is a quality found in all children. Those who are full-blooded and have not been constantly thwarted by the cry of "Don't!" have an inexhaustible supply of it, and this is precisely what we want. It is the source of power, and jealously to be guarded. The particular merit of the new education, represented by the kindergarten, sloyd and manual training, lies in this, that they proceed psychologically. They recognize the child's desire as the source of action and effort, and build upon that. What we want to do is to turn these desires into the most wholesome channels, and to have the activity spend itself along the most helpful lines. So long as the desire is genuine, is the child's very own, and the activity which follows, a legitimate result of the desire, we may feel quite sure of the resulting sensations and their assembly into thought. What I dread most as a teacher is the child devoid of feeling and desire, the quiet little mouse who under the old *régime* would be called good and held up as a pattern. To keep quiet and vegetate is not to be good. The troublesome child, full of action and desire, is the far more promising bit of humanity. In the first there is nothing to work upon, poor little anæmic creatures with no past, no present, and no probable future. But the second is a storehouse of power. Education has something to work upon. It has a more lively problem, it is true, and one of some difficulty, but withal a problem of keen interest and large promise. Believing this as strongly as I do, the systems of education which begin by repression, by a process of subduing, quieting, deadening the activities and desires of childhood, seem to me absolutely vicious—more vicious by far than the conduct of nurses who feed troublesome babies with soothing sirups and other detestable drugs to put them to sleep.

The children themselves suggest the right method in education. What they most want is to be employed, and with something that interests *them*, not something that interests mamma or papa or the teacher. Consult any child of your acquaintance

—any unsophisticated child, I mean—and get at his preference for one place over another. I think you will find, for example, that he prefers the shabbiest old farmhouse to the trimmest village mansion; and the reason is simple—there is more to *do* there. This is the great fact that the newer education has seized upon. It attempts to make knowledge real to children by making it a part of their experience, and to do this it enlists the life forces on its side instead of arraying them against it. As educators, we are to use our skill in directing the wonderful self-activity that in children is already a reality. We are to provide the theater for its exercise, and decide, in large measure, what shape it is to take. But always we are to do this with the sympathy and co-operation of the child, and never against his protest. It is bad practice in medicine to deal with symptoms and treat only them. It is good practice to go back of symptoms to causes. It is bad practice in education to attempt to control the occupations and activities of children, and neglect the motive power back of it all. It is good practice to accept the desires of children and allow them wholesome expression. A large part of the childish instinct is the desire to make things, to construct something—anything, indeed, from a mud pie to a canoe or playhouse. It is a wholesome instinct. It is only by such experience that the child comes to know the great outer world and to find himself in it. Think for a moment how much he has to learn; how much that to you and me are mere commonplaces, but to him are brand-new wonders! He is a born investigator, an inquisitive experimenter in a very large laboratory. And not only this, but it is very desirable that he should be. To prohibit these activities, to thwart these instincts, and to deliberately propose as a substitute that he shall sit still indoors with the abstractions of formal education is simply grotesque. If the proposition and the carrying out of it did not involve so much mischief of a very grave sort, they would be highly humorous. No educational ideas are defensible which have not their foundation in ethics, and one's ethics, I need not add, must rest upon one's philosophy of life. In proposing to respect the desires of children, or, in a word, to let them have their own way, I am proposing something quite at variance with the ethical ideas of the majority of people and notably at variance with the Puritan ethics, yet I do it on ethical as well as psychological grounds. It is a moral universe, this, in which we find ourselves—a universe so constituted that health-giving activities are followed by happiness, and evil activities by pain. It is this, indeed, that constitutes the rightness or the wrongness of the action—the good or bad results. If we wish to make the moral life a reality, we must from the cradle up let children feel this essential relation between cause and effect, and discriminate between

good-producing and bad-producing action. You must not misunderstand me. I would, of course, try very earnestly to influence the desires of children, to make them want the things that the experience of the race has shown to be good and wholesome, but it seems to me of greater moment to have the desire and the action harmonize than to have the action which would seem to us always commendable. We would not, I think, run any very great risk. Healthy children, living under wholesome conditions, have, in the main, wholesome desires. And desires that are not wholesome can not be more thoroughly killed than by allowing them, if possible, to flower into action which the child himself will recognize as painful. No greater wrong can be done a child than by associating in his mind what is right with what is painful, and what is wrong with what is pleasant. It is an utterly false association. He will attain the highest morality when he does simply and naturally the thing that is good-producing without any inner conflict, but solely as the result of cultivated instincts.

I read once the gospel credited to John, making careful note of all reference to miracles. I was struck with the fact that all of the reported events had to do with some physical want—the curing of the sick, the feeding of the hungry, the raising of the dead. You will notice in studying the inclinations of childhood a similar uniformity. They are all physical wants, and may be summed up for the most part in two words—muscular exercise. The children are right. It is this exercise that is going to strengthen all the organs and make them capable of more perfect function. Every physical act has its corresponding mental act, and it is a succession of these acts that develops the gray and white of the brain and gives us at last a highly evolved and sensitive organism. The work of education consists in directing these activities into those channels which will yield the most helpful reactions. By concentrating the wandering attention, by increasing the delicacy of touch, by cultivating a finer and finer discrimination, by training the observation—in a word, by developing, as far as may be, each and all of the faculties—we make possible that unfolding and perfecting of the human spirit, that evolution of human nature, which is the end in education.

The goal of modern education is not reached through manual training alone, any more than it is through language or science or mathematics. It is for this reason that I no longer desire to see the establishment of manual training schools as such. They were necessary in starting the movement. This side of things had to be emphasized, and the early manual training schools did yeoman service. But now it seems to me far more wholesome and desirable that manual instruction should be introduced into

the lower and secondary schools already in existence, and that the work should take its place alongside of the other recognized means of culture. It has a substantial contribution to make toward that fullness of life which is the modern aim. It enlarges the experience of children by bringing them into closer contact with the outer world of force and matter; it develops that many-sided interest which gives alertness to youth and redeems old age from *ennui;* it increases the sensitiveness of the bodily organism; it makes possible activities which would otherwise be impossible; in a hundred ways it makes for righteousness—that righteousness which consists of fullness of life.

And the method of the new education is admittedly psychological. It is in harmony with the desires of childhood. It offers occupations which are welcome to the children, and at the same time rich in thought reaction. It is a proposition to educate children through their own self-activity, with their co-operation instead of against their protest.

In estimating the several forms of manual training, I have come to believe that the Swedish form, sloyd, has some advantages over the more formal Russian manual training, in giving better gymnastics in its movements and a more human interest to its occupations. A finished article makes a stronger appeal to the childish sympathy than the abstract exercises of manual training proper. It is psychologically truer and, I believe, morally more effective. Children wholesomely occupied, children busy in trying to realize some form of usefulness and beauty, must, I think, daily grow into that unconscious goodness which I hold to be the highest morality; must illustrate Emerson's favorite doctrine, that evil, like cold, is a negation, is but the absence of good.

I have indicated the ideal in modern education. I have tried to indicate somewhat of the method. The practical question remains: Who shall carry it out? It would be unfortunate to intrust this most important interest of society to any but the best men and women, and by best I do not mean those who know the most, but those who are the strongest, the most beautiful, the most lovable, the most cultured, as well as the most skillful and the best informed. And in the newer education the need for wise and beautiful teachers is particularly great. Now that education has taken this truer and more psychological turn and is building its work upon the basis supplied by Nature, upon the feelings and desires of childhood, upon its wonderful self-activity and constructive instinct, you can readily see how utter will be the defeat if the realization of the method be left in the hands of men and women devoid of the requisite insight. Profoundly as I believe in this aspect of education, in the underlying principles of the kindergarten, sloyd, and manual training, I greatly prefer the

old academic training, with all its defects, in the hands of earnest, cultured men and women, to the most elaborate carrying out of the newer methods in the hands of those who do not see the end and purpose.

Mistakes bear a certain family likeness. The most tangible element in the older education was knowledge. Teachers were selected for their knowledge alone, and education was defeated. The most tangible element in the newer education is dexterity and its product, the finished exercise. But this is likewise the product of our industrial operations. Externally the school and the factory resemble each other. Both make things. But the difference is this, and it is a great one: The school concentrates its effort upon the making, and has regard only to the little workman; the factory values only the thing made, and is indifferent to its effect upon the worker. What a sad travesty when the modern school loses sight of this immense difference! The effort to turn children into artisans, and to do it in the name of education, is quite as unfortunate as the more ancient effort to turn them into encyclopædias. From the very circumstances of the time, it is far easier to establish one of these factory schools than it is to establish a true school. For, observe the teaching material that is available. It is difficult to find men and women of broad culture who can also use their hands. It is very easy to find artisans who are willing to exchange the smaller pay and longer hours of the shop for the pleasanter work of the schoolroom. They believe very sincerely that the only qualification is the ability to turn out good work. I admire their dexterity, I respect their earnestness, but I say to them and I say to you that this is not enough. The artisan habit of thought does not make for the unfolding and perfecting of the human spirit. By the very conditions of his life, the artisan is a man of limited experience, and consequently of narrow views. He is not the sort of man qualified to educate our children. His thought is directed solely toward the product. His skill is in the handling of dead material. What we want is something different from this; it is a man whose thought is on the process, whose cunning is in the handling of the living material, the tissue of childhood.

I have had a distinct purpose in mind in writing this article. I shall have satisfied it if I have gained the reader's assent to three propositions:

1. That the object of modern education is fullness and integrity of living; is the most complete unfolding and perfecting of the human spirit; is the development of the more evolved out of the less involved self.

2. That the method by which this object is to be attained must be psychological. Its foundations must be laid deep in the

emotional life of childhood, in the desires and feelings. It must allow these to express themselves in sincere action. It must preserve inviolate the causal chain of desire, action, sensation, thought. Its philosophy must be monistic. It must hold fast to the organic unity of the child.

3. That the proper agents for carrying out this method and gaining this end are the best men and women that society has produced, the very flower of the race, men and women of large experience and broad culture in whom the pulse of life beats quick and high; not bookworms, not artisans, not fragments of any sort whatever, but men and women to whom Nature and circumstances have been kind, who have caught sight of the vision of the complete life, and who would make this vision prevail.

EARLY YEARS OF THE AMERICAN ASSOCIATION.

By WILLIAM HENRY HALE, Ph. D.,
FELLOW OF THE ASSOCIATION.

IN this age of increasing specialization and multiplying societies and organizations of specialists it is well that there still remains an association broad enough to include the entire range of scientific thought and activity, and comprehensive enough to welcome all who have the disposition to explore any field in the vast domain of science.

The American Association for the Advancement of Science has now for nearly half a century been a powerful factor in stimulating the progress of scientific research in America. Similar associations are found in other countries. The pioneer of all is the British Association for the Advancement of Science, which was founded at York, England, in 1832. The period following this epoch was marked by a great outburst of the spirit of research and investigation among the English-speaking people. In America the science which gained the greatest number of adherents and was prosecuted most vigorously was geology. During the decade following the organization of the British Association, James Hall was laying the foundations of that science in America by his explorations of the strata of the State of New York; Bela Hubbard was exploring the new State of Michigan; Benjamin Silliman was teaching at Yale; James D. Dana completed his college course as a pupil of Silliman, and already made a name for himself in scientific circles; and Edward Hitchcock was finding the puzzling fossil footprints of primeval reptiles, so long erroneously called "bird tracks," along the valley of the Connecticut.

The city of Philadelphia was then an important scientific center. A number of geologists resided there, and were wont to hold occasional meetings. At last it seemed desirable to convene a larger and more general assemblage; and on the 2d day of April, 1840, about twenty geologists, including nearly all the most prominent ones in America, met there and organized "The Association of American Geologists." Edward Hitchcock presided, and Lewis C. Beck was secretary. Of the founders of this association who attended this first meeting, three venerable men still survive—James Hall, of Albany; Bela Hubbard,* of Detroit; and Martin H. Boyé, of Coopersburg, Lehigh County, Pennsylvania. Several of the older States were represented, including Massachusetts, New York, Pennsylvania, Delaware, and Virginia. Of the Western States, Michigan alone had then instituted a geological survey; and Bela Hubbard and Douglas Houghton traveled that long journey together from Michigan to Philadelphia. It took them an entire week, traveling day and night by the most direct route; and the roads in Ohio were so muddy that the passengers often had to alight and assist in pulling the stage out of the mud.

James Hall, surviving founder of the Association of American Geologists and of the A. A. A. S., and oldest surviving past president, Albany, 1856.

The next year (1841) the geologists met again in Philadelphia, and many new members were added. In 1842 the meeting was held in Boston, where several naturalists came into the association, and the name was changed, mainly through the influence of Amos Binney and Augustus A. Gould, to "The American Association of Geologists and Naturalists." Subsequent annual meetings were held in Albany, Washington, New Haven, New York, and Boston.

Several years after the association was founded the chemists and physicists proposed to join, and in 1848 another meeting was

* When this article went to the printer Bela Hubbard was dangerously ill, and his death occurred on June 13th. Recent letters from him have furnished some of the most interesting of these reminiscences.

held in Philadelphia, and on September 20, 1848, the original organization was changed to the "American Association for the Advancement of Science."

William B. Rogers presided at the dissolution of the Association of Geologists and Naturalists, and yielded the chair to William C. Redfield, the first President of the American Association for the Advancement of Science.

Prof. Redfield was a resident of New York city and a pioneer in the study of meteorology. He published a theory of storms which became well known and was strenuously controverted by Espy, so that the storm controversy was a conspicuous feature of scientific annals. Prof. Redfield's influence had much to do with the establishment of the Weather Bureau of the United States.

The association began with a membership of four hundred and sixty-one, which increased to a thousand and four in 1854 at the Washington meeting under the presidency of James D. Dana. This was high-water mark for the first thirty years of its existence. In 1850 and 1851 two meetings were held in each year, but none in 1852. Thereafter annual meetings were held till 1860. The presidents during this period, besides those already mentioned, were Joseph Henry, Alexander D. Bache, Louis Agassiz, Benjamin Peirce, John Torrey, James Hall, Stephen Alexander, and Isaac Lea.

Dr. Martin H. Boyé, surviving founder of the Association of American Geologists and of the A. A. A. S.

Of this illustrious roll, James Hall alone survives. He presided at the second Albany meeting in 1856, when the old Dudley Observatory was dedicated, the largest, most important, and most representative scientific meeting ever held in America before the war. The glowing eloquence of Edward Everett in his dedicatory oration, delivered in a tent erected for the occasion in the historic park of the Albany Academy, still haunts the memory of the writer, who was then a pupil in that academy. Meetings of the association during the *ante-bellum* period were held as far east as Cambridge and as far west as Cincinnati, while Montreal and Charles-

ton, S. C., were the extremes north and south. New Haven, Cleveland, Washington, Providence, Baltimore, Springfield, and Newport were also visited.

The association adjourned at Newport in 1860, intending to meet at Nashville in 1861, but the war intervened, and the meeting could not be held; and there were no other meetings till 1866, when seventy-nine members met at Buffalo and reorganized the association. Since that time Buffalo has been a sort of Mecca, and every tenth year we reassemble there. The president at the first Buffalo meeting was Frederick A. P. Barnard, President of Columbia College. At the second Buffalo meeting William B. Rogers, already mentioned as the last President of the American Association of Geologists and Naturalists, presided. Edward S. Morse was president at the meeting in 1886. Edward D. Cope, of Philadelphia, has been elected president for the meeting of this year.

William C. Redfield, first President A. A. A. S., Philadelphia, 1848.

Since the reorganization at Buffalo the association has expanded and developed in many ways. At the Hartford meeting in 1874 it was incorporated under the laws of the State of Massachusetts, and it has its headquarters and museum at Salem. At the Hartford meeting also provision was made to apply the designation of "fellows" to such of the members as were devoted to science or had advanced the cause of science, and one hundred and fifty-seven members were thus constituted fellows, of whom about one half still survive. Since that time the number of fellows increased year by year, till in 1893 there were seven hundred and ninety-six, while the membership of the association reached its maximum of two thousand and fifty-four in 1891. The largest attendance of members was at Boston in 1880, when nine hundred and ninety-seven were registered. At Philadelphia in 1884 the registration reached twelve hundred and sixty-one, but nearly three hundred of this number were visitors from the British Association, which

had just held a meeting at Montreal, and from other foreign bodies.

The division of the association into sections began at the Detroit meeting in 1875, when two sections were formed: Section A, Mathematics, Physics, and Chemistry; and Section B, Natural History. At the second Montreal meeting in 1882 a much more extended subdivision was made, the following having been established: Section A, Mathematics and Astronomy; B, Physics; C, Chemistry; D, Mechanical Science and Engineering; E, Geology and Geography; F, Biology; G, Microscopy; H, Anthropology; I, Economic Science and Statistics. In 1886 Section G was united with Section F, and in 1893 Section F was divided into Section F, Zoölogy, and Section G, Botany. The name of Section I was changed in 1895 to Social and Economic Science.

A notable feature of recent meetings of the association has been the large number of affiliated societies which meet at about the same time. The first of these was the Society for the Promotion of Agricultural Science, which was organized at Boston in 1880. Others were added from time to time, till at Brooklyn, in 1894, there were nine, viz., the Society for the Promotion of Agricultural Science, Society for the Promotion of Engineering Education, American Mathematical Society, American Chemical Society, American Microscopical Society, American Forestry Association, Association of Economic Entomologists, Association of State Weather Services, and American Geological Society, besides the Botanical and Entomological Clubs of the association. At Brooklyn also was organized the American Botanical Association. It has been doubted whether these numerous societies do not detract from the interest in the main association, and action was taken at the second Springfield meeting in 1895 in the direction of making them business meetings rather than meetings for the reading of papers.

Frederick A. P. Barnard, President A. A. A. S., first Buffalo meeting, 1866.

Meetings have been held since the war in Maine, Vermont,

Massachusetts (three), Connecticut, New York (eight), Pennsylvania, District of Columbia, Ohio (two), Indiana (two), Illinois, Michigan (two), Wisconsin, Minnesota, Iowa, Missouri, Tennessee, and Canada (two). The list of past presidents includes, besides those previously mentioned, John S. Newberry, Benjamin A. Gould, John W. Foster, T. Sterry Hunt, Asa Gray, J. Lawrence Smith, Joseph Lovering, John L. Le Conte, Julius E. Hilgard, Simon Newcomb, Othniel C. Marsh, George F. Barker, Lewis H. Morgan, George J. Brush, J. William Dawson, Charles A. Young, John P. Leslie, Huber A. Newton, Samuel P. Langley, John W. Powell, Thomas C. Mendenhall, George L. Goodale, Albert B. Prescott, Joseph Le Conte, William Harkness, Daniel G. Brinton, and Edward W. Morley.

William B. Rogers, President A. A. A. S., second Buffalo meeting, 1876.

The president elect, Edward Drinker Cope, was born of Quaker ancestry at Philadelphia, July 28, 1840. He was educated at the Westtown Academy and the University of Pennsylvania, and afterward studied comparative anatomy in the Academy of Sciences, Philadelphia, and the Smithsonian Institution at Washington, and later in Europe. He was Professor of Natural Sciences at Haverford College from 1864 till 1867, resigning in the latter year because of ill health. Later he was paleontologist of the United States Geological Survey, serving first in the Territories west of the one hundredth meridian. His discoveries were numerous

Edward S. Morse, President A. A. A. S., third Buffalo meeting, 1886.

and important, including a thousand or more extinct and nearly or quite as many living vertebrates.

Prof. Cope was for many years secretary and curator of the Academy of Natural Sciences of Philadelphia, and chief of the department of organic material of the permanent exhibition of that city. He was elected a member of the National Academy of Sciences in 1872. He has published numerous works of a scientific nature, including several hundred papers, and dozens of larger works. He has for many years edited the American Naturalist.

EDWARD D. COPE, President elect A. A. A. S., fourth Buffalo meeting, 1896.

The fourth Buffalo meeting is to be held in the week beginning August 24th. Mayor Jewett is president of the local committee, and Eben P. Dorr is local secretary. Prof. Frederick W. Putnam remains permanent secretary, having filled that office during the greater part of the existence of the association.

The association assembles this year at Buffalo at an epoch marked by wonderful advances in applied science. The harnessing of Niagara, and the utilization of that immense power for electrical and manufacturing purposes, will furnish the most impressive object lesson which has ever been presented to the association in the whole forty-eight years of its existence. The study of Niagara has been an absorbing feature of all the Buffalo meetings. Heretofore it was the geology of that stupendous gorge which appealed most strongly to the attention of visitors. Now the new and diversified uses of the energy set free by the cataract will invest the visit to Niagara with new importance and significance.

PROF. G. STANLEY HALL expressed the opinion, at the recent meeting of the American Antiquarian Society, that the difficulties of the American people with the Indians had arisen from trying to educate them along a line with which they have no sympathy, and with which they can not assimilate, instead of encouraging them in improving their own scheme of life.

"SPIRIT" WRITING AND "SPEAKING WITH TONGUES."

By Prof. WILLIAM ROMAINE NEWBOLD.

THE word "automatism" not only designates a group of phenomena but also connotes a theory as to their origin, and this theory rests upon the popular conception of the relation of "soul" and body. The soul, according to it, is an entity of a peculiar kind, entirely distinct from and independent of the body. The body is a material machine, and does not essentially differ from the machines made by man. The relation between soul and body is one of reciprocal action and interaction. The body is the medium through which material realities external to it are communicated to the soul under the guise of the sensations and conceptions of consciousness; it possesses also the capacity of executing certain movements—as, for example, reflexes—without the concurrence of the soul. But the more complex movements of the body, especially those which adjust it to a constantly shifting environment and those which serve as the exponents of mental life, can not be executed without the co-operation of the soul. Occasionally these normal relations appear to be disturbed. Movements take place of the kind usually ascribed to the activity of the soul, and that soul disavows them. Sensations and perceptions enter into the range of consciousness for which no external reality can be found, and thoughts strangely unlike those proper to the thinker troop through his mind and force themselves upon his unwilling attention. These phenomena are ascribed to the agency of the body as distinguished from that of the soul on the one hand, and that of the material world on the other. The body is a machine out of gear; it is no longer controlled by the indwelling soul, and is constantly executing movements on its own account and forcing upon the soul sensations, perceptions, and ideas which stand for no realities save that of the disordered mechanism which produces them. Thus the three chief forms of automatism are: the automatism of movement, of sensation, and of thought or ideation. While I shall use the word automatism and its derivatives, I do not, of course, wish to be understood as subscribing to the theory which it connotes.

Automatic movements may be of any and all kinds. The simplest are those of which the actor is thinking at the time although himself unaware that his thought is passing over into movement. To this type belong the marvels of the pendulum which swings above a reflecting surface only, of the divining rod, of most forms of table-turning, of "thought transference" as practiced by Bishop and Cumberland, *et id genus omne*. Space forbids my entering

into the discussion of these relatively familiar cases, and I shall turn at once to the more complex types.

Automatic writing is an exceedingly common phenomenon. It took its rise from table-turning. Ordinary tables being found in many cases too heavy for the "spirits" to lift, tiny three-legged tables were made for the purpose and termed "planchettes." Later the device was hit upon of attaching a pencil to one leg and placing a sheet of paper beneath to record the movements of the leg. This is our modern planchette. Two or three persons then put their hands on the instrument and wait to see "what planchette will say." Many automatists need no planchette. It is enough for them to take a pencil in hand and sit quietly with the hand on a sheet of paper. After the lapse of a variable period of time the hand will stiffen, twist, and fall to writing quite of its own accord. Of these methods planchette is the more likely to be successful. In the first place, the chances of finding an automatist among two or three people is obviously greater than in the case of one; furthermore, since all expect planchette to move, the slightest tendency to automatism on the part of any one is likely to be magnified by the unconscious co-operation of the others, and is less likely to be checked by the writer himself, since each ascribes the movement to any one but himself.

The writing produced by either of these methods may be regarded as belonging to one of two main types: 1. That which, although involuntary, is dependent upon the co-operation of the subject's consciousness. 2. That which is produced without the co-operation of the subject's consciousness. The latter, again, may be either intelligible or in "unknown tongues."

Intelligible automatic writing may be produced without the co-operation of the subject's consciousness, either when that consciousness is apparently unimpaired, or when the patient is in a trance state. The latter I need not now discuss, as it belongs to the same category as dreams, but the former calls for some comment.

There are two methods of proving that the automatic messages did not emanate from the subject's upper consciousness. In the first place, it is sometimes found that they become the more clear and copious the more effectually the upper consciousness of the subject is distracted from the writing. Miss G——, for example, whom I studied with some care, always did her best automatic writing when busily engaged in conversation or in reading aloud. I concealed her hand from her eyes, and it was but now and then that she would decipher a word by the sense of touch and movement as it was written. But the messages she wrote were always trivial, silly, and often self-contradictory.

In the second place, the content of the writing may be of such

a character that we can scarcely ascribe it to the subject's consciousness. In hysterical patients, for example, the upper consciousness, or at least the consciousness which talks, is often anæsthetic to one or more sensory stimuli, yet the automatic writing betrays consciousness of the lost sensations. Prof. James, of Harvard, has noted the same phenomenon in an apparently normal patient.* "The planchette began by illegible scrawling. After ten minutes I pricked the back of the right hand several times with a pin; no indications of feeling. Two pricks on the *left* hand were followed by withdrawal, and the question, 'What did you do that for?' to which I replied, 'To find out whether you are going to sleep.' The first legible words which were written after this were, '*You hurt me.*' A pencil in the right hand was then tried instead of the planchette. Here again the first legible words were, '*No use* (?) *in trying to spel when you hurt me so.*' Next, '*It's no use trying to stop me writing by pricking.*' These writings were deciphered aloud in the hearing of S——, who seemed slow to connect them with the two pin-pricks on his left hand, which alone he had felt. . . . I pricked the right wrist and fingers several times again quite severely, with no sign of reaction on S——'s part. After an interval, however, the pencil wrote: '*Don't you prick me any more.*' . . . S—— laughed, having been conscious only of the pricks on his left hand, and said, 'It's working those two pin-pricks for all they are worth.'" Yet the hand was not anæsthetic when directly tested.

Sometimes the automatic message is potentially known indeed to the upper consciousness, but not at the time present to it. Take, for example, one of Mr. Gurney's experiences: †

"In 1870 I watched and took part in a good deal of planchette writing, but not with results or under conditions that afforded proof of any separate intelligence. However, I was sufficiently struck with what occurred to broach the subject to a hard-headed mathematical friend, who expressed complete incredulity as to the possibility of obtaining rational writing except through the conscious operation of some person in contact with the instrument. After a long argument he at last agreed to make a trial. I had not really the faintest hope of success, and he was committed to the position that success was impossible. We sat for some minutes with a hand of each upon the planchette, and asked that it should write some line of Shakespeare. It began by seesawing and producing a great deal of formless scribble; but then there seemed to be more method in the movements, and a line of hieroglyphics appeared. It took us some time to make it out, the

* Proceedings of the American Society for Psychical Research, vol. i, p. 549.

† Proceedings of the Society for Psychical Research, vol. iv, p. 301, note.

writing being illegible just to that degree which at first baffles the reader, but which afterward leaves no more doubt as to its having been correctly deciphered than if it were print. And there the line indubitably stood: '*A little more than kin and less than kind.*' Now, as neither of us had been thinking of this line, or of any line (for we had been wholly occupied with the straggling movements of the instrument), the result, though not demonstrative, is at any rate strongly suggestive of a true underground psychosis."

At other times the information conveyed is at once true and quite unknown to the subject. Some of these cases are undoubtedly due to the automatic reproduction of memories which can not at the time be recalled—a common phenomenon in all forms of automatism. Thus, in the case of B——, to which I shall refer at greater length hereafter, it was stated that a man named Parker Howard had lived at a certain number on South Sixteenth Street, Philadelphia. Upon going to the house, I found that a man named Howard—not Parker Howard, however—had lived there some time, but had moved away about two months before. Moreover, the whole Howard incident proved to be mythical; no such person as Parker Howard ever existed. But B—— told me that after his hand had mentioned the name, and before the address was given, he stepped into a shop and looked through a directory for the name. Probably, as he glanced over the list of Howards, his eye had fallen upon the address which his hand afterward wrote, but he had no recollection of it.

Many other cases are certainly due to accidental coincidence. B——, for example, wrote long accounts of events happening at a distance from him, which were afterward found to be in the main correct; but that this was a mere matter of chance was abundantly proved to B——'s own satisfaction. The chances of coincidence are much increased by the extremely illegible character of much of the script, which leaves wide room for "interpretation." I can not but suspect that the "anagrams" sometimes written automatically often owe their existence to this kind of "interpretation." Yet, after making all allowances for coincidence and forgotten memories, nearly all investigators admit that there remains a residuum which can not plausibly be explained by any accepted theory. I can not discuss this residuum here; it is enough to point to its existence, with the caution that no theory can be regarded as final unless it can explain all the facts.

The importance of this material from a psychological point of view can not be overestimated. If the man's hand can write messages without the co-operation of the man's consciousness, we are forced upon the one horn or the other of a very perplexing dilemma. Either these utterances stand for no consciousness at

all, merely recording certain physiological processes, or else they indicate the existence of mentation which does not belong to any recognized human being. The first would seem to deny the doctrine of parallelism, according to which physiological processes of the degree of complexity requisite to the production of writing necessarily generate mental states, and this would lead us toward the old theory of the soul, or something like it. The second would compel the assumption either of personalities distinct from that of the subject, which is the theory of possession, or of segregated mental states. The latter is the theory which I am developing in these pages, and although I am far from satisfied with it, it is more in line with our present scientific conceptions than others, and accounts for some of the facts fairly well.

But this dilemma presents itself only when it can be shown that the subject's upper consciousness has nothing to do with the

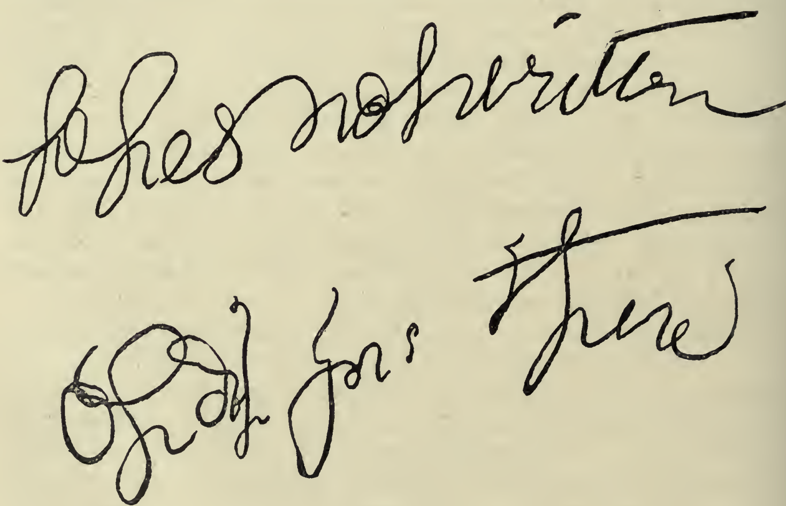


Fig. 1.

production of the writing. I am convinced that experimenters do not pay sufficient attention to this point, and consequently much of the recorded material is to my mind of little significance. As my space is limited, I wish to lay especial stress upon this aspect of the problem.

A few years ago I had the opportunity of studying at leisure a remarkably good case of automatism. The subject, whom I shall call B——, was a man of intelligence and education, with whom I had long been on terms of intimacy, and of whose good faith I can therefore speak with some confidence. The writing was at first a mere scrawl, accompanied by quite violent twisting of the arm; little by little it became intelligible, wrote "Yes"

and "No," took to printing in large capitals, and finally fell into an easy script almost identical with B——'s normal hand. The communications always professed to emanate from spirits, and, on the

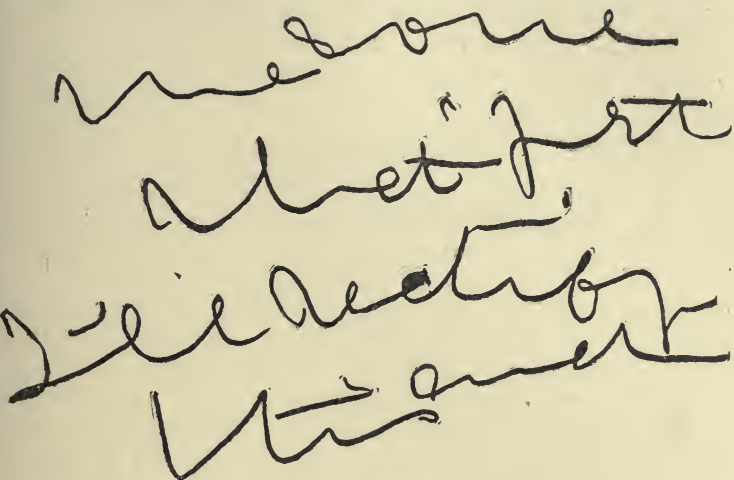


FIG. 2.

whole, fulfilled in phraseology, style of script, etc., B——'s notions as to what the alleged spirit ought to say and write. One "spirit," for example, was R——, to whom writing had been ascribed by another automatist whom B—— had seen, and his writing, as executed by B——'s hand (Fig. 1), was clearly a rough imitation of the original (Fig. 2). Fig. 3 represents the script of another mythical spirit. Yet another alleged communicator was the late Stainton Moses; Fig. 4 is his signature as written by B——'s hand; Fig. 5 is a facsimile of his actual signature, which B—— had seen. I think there is here also an attempt at imitation, although a very bad one. Another "communicator" began as shown in Fig. 6; he then announced that he was born in 1629, and died in 1685. Now, B—— knows a little about seventeenth-century script, and he instantly saw that this did not resemble it. Scarcely had he noticed the discrepancy when his hand began writ-

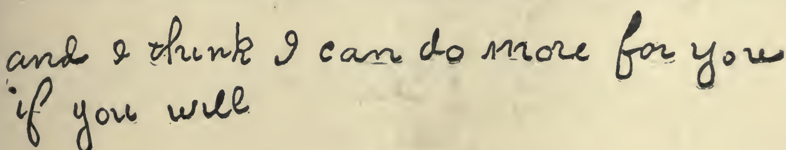
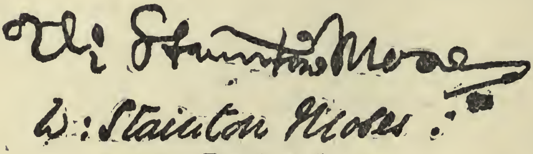


FIG. 3.

ing the script figured as No. 7, which is not unlike that then in use. B—— thought at the time that he could not write this hand voluntarily without taking pains, but upon attempting it he

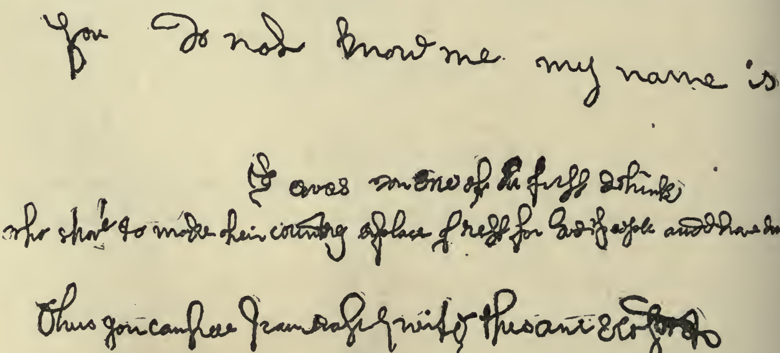
found that he could do it voluntarily as well as automatically (Fig. 8).

It was easy enough to prove that these communications had nothing to do with spirits. B—— satisfied himself upon that point in a very short time. But we kept on experimenting, to determine whether they were of subconscious origin or not. To B—— himself they felt strangely external. To quote his own words:



Figs. 4 and 5.

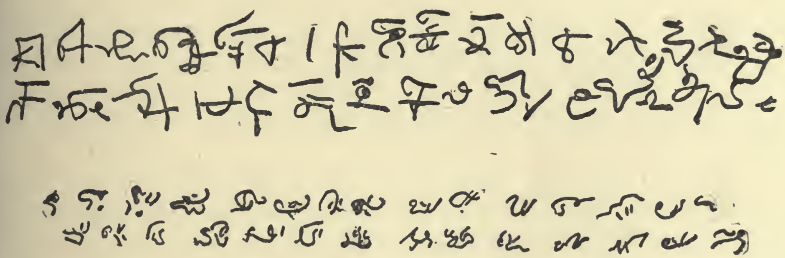
"When I wish to write automatically I take a pencil and place my hand upon a sheet of paper. After the lapse of a few minutes I feel a tingling sensation in my arm and fingers; this is followed by a stiffening of the arm and by convulsive movements. After scrawling for a while, it will make a mark which suggests to me the beginning of a letter, and usually the letter will be clearly written almost before the thought enters my mind. It is then followed by some word beginning with that letter, and that by other words, constituting a 'communication' from some 'spirit.' The writing then proceeds quite rapidly. It seems to me that I read it as it is written; sometimes I apparently anticipate the writing, but quite often it does not proceed in accordance with my anticipation. Sometimes the writer seems to be at a loss how to complete his sentence, and begins again. At other times an illegible combination of signs will be repeatedly written, until



Figs. 6, 7, and 8.

finally a word is evolved, and this appears to be what the writer had in mind at the outset. I am now satisfied, however, that there is never any foresight; my hand simply develops the illegible scrawl into the word which I think it most resembles, thus ful-

filling my expectations. This is curiously shown in the emotion it displays. It will twist violently about, pound on the table, bruise my fingers, break my pencils, and show every sign of the greatest excitement, while I, the spectator, survey it with the coolest and most skeptical curiosity. But it will do this only when such emotion seems to me appropriate, just as the persons I see in my dreams may manifest an emotion which I do not share. My hand sometimes abuses me, especially for my skepticism, and sometimes reproves my faults in a very embarrassing manner. It has frequently urged me, upon very plausible grounds, to do things which I would not dream of doing. In every case save one the reasons given were untrue, and in that one I am satisfied the coincidence was due to chance. On two occasions my hand wrote a short stanza with little hesitation. I have never done such a thing myself, but the verses were so incoherent and so atrocious



FIGS. 9 AND 10.

that I have no doubt they were developed successively, each being based upon the suggestions of the preceding in the manner above described."

I can see no reason for ascribing B——'s writing to subconscious states. It was never intelligible unless B—— allowed himself to "read" it. If he persistently distracted his attention or refused to wonder what his hand was trying to write, it would make marks resembling writing, but never "wrote sense." It was highly suggestible. If he wondered why it did not print, it would instantly try to print; and if, while trying to print, he refused to wonder what it said, it produced strange characters resembling some unknown language. Fig. 9 is a facsimile of a few of these; they were written as rapidly as the hand could fly. Fig. 10 is a facsimile of some writing executed by a Dr. Mayhew, October 5, 1853 (*Neueste spiritualistische Mittheilungen*, Berlin, 1862), and purports to be an account written by a spirit from the planet Saturn of the Saturnian mythology. In this case the spirit kindly wrote a "translation" giving the general sense, and in B——'s case, had he for a moment believed that the writing was intelligible to the writer, I have no doubt that a "translation"

would have been as promptly forthcoming. This automatic production of mysterious characters is not uncommon. Prof. James, of Harvard, has examined many cases, but neither he nor any one else has ever, so far as I know, found any that could be deciphered.

Thus, the intelligibility of B——'s script is fully accounted for; but its automatic character remains more or less of a puzzle. I am inclined to regard it as due to the spontaneous "running" of some parts of the nervous mechanism which have nothing to do with consciousness. Precisely *what* parts we can not say, but if we suppose that consciousness accompanies cortical processes only, we may also suppose that they are to be found in the re-enforcing and co-ordinating mechanism of the great basal ganglia. If so, this case might be regarded as strictly automatic—i. e., as due to mechanical causes only.*

I do not believe that all cases of automatic writing can be explained in this way; but I am convinced that experimenters do not take sufficient pains to eliminate the action of the subject's consciousness. They seem to think that where the sense of voluntary effort is lacking the subject's consciousness can not interfere.

For the first carefully observed and reported case of automatic speech we are indebted to Prof. James, of Harvard. His paper, together with an account written by the subject, will shortly appear in the Proceedings of the Society for Psychical Research. I have not yet seen it, but he has kindly allowed me to make an independent study of the case for myself and to make use of it in this connection. The subject, whom I shall call Mr. Le Baron, is an Englishman thirty-eight years of age, is a man of education, has written a novel, a volume of poems, and a treatise on metaphysics, and is a reporter for a daily paper. In the summer of 1894 he fell in with a group of persons interested in occultism, and his association with them appears to have brought to the surface tendencies to automatism which had already manifested themselves sporadically. Of this association he thus speaks: "Before and almost immediately preceding this 'speaking with tongues' my nature had undergone a most remarkable emotional upheaval, which terminated in a mild form of ecstasy. Credulity and expectation are twin brothers, and my credulity was first aroused by the earnest narration of divers 'spiritualistic' experiences by a cultured lady of beautiful character, fine presence, and the noblest of philanthropic intuitions. A number of persons associated with this lady in her work secretly believed themselves

* Some further details about this case can be found in my paper, The Experimental Induction of Automatic Processes, in the Psychological Review, July, 1895.

the elected 'spiritual' vanguard of humanity. Not to understand these facts is not to understand the potent factors giving rise to the phenomenon."

In some way or other this group of occultists, whose leader I shall call Miss J——, got the notion that Mr. Le Baron was the reincarnated spirit of the Pharaoh of the Exodus. Miss X——'s mother, they thought, had loved that king in a previous incarnation, and was still watching over his transmigrations. The time was now ripe for him to be forgiven his sins and to be brought to the light, and she was to make of him an instrument for a fuller revelation of God to humanity. They impressed this delusion upon Mr. Le Baron with all the energy of conviction. "Unless it be borne in mind," he says, "that the air was full of a greedy expectancy concerning the appearance of a reincarnated prophet, no solution of this problem is possible." His common sense protested, and he would not, perhaps, have been much affected had not a traitor within the camp presented itself in the form of his own highly suggestible and excitable nervous system, which caught the ideas with which he was surrounded and reflected them to the confusion of his understanding. This automatism first appeared in the form of writing. "My credulity was as profoundly sincere as it was pitifully pathetic. It was aroused by the narration of the purported history of a finger ring supposed to have been worn ages ago by a vestal virgin in one of the ancient temples of Egypt. Miss J—— believed she wore the ring in those days, and was herself the vestal virgin. On one occasion, in August, 1894, she asked me to place the ring on my finger and attempt automatic writing. I did so. Violent jerks followed, leading to scribbling upon the sheets of paper which were laid before me. This she attributed to spirits, and the placing on of the ring was in some way a sign to call them into activity. The 'invisible brotherhood' were subsequently declared to be *en rapport* with me, and in the exact ratio of my credulity concerning this assertion did this singular, insentient, emotional mechanism co-operate with the sensations of my common consciousness, and at times assume intelligible proportions."

The circumstances under which automatic speech appeared he was not able to fix with precision. He recollected two occasions, but was not able to say which came first. On one, he was at a *séance* at Miss J——'s house. He was asked to lie upon a couch upon which Mrs. J—— had lain during her last illness, and to look at a brilliantly illuminated portrait of her. In a short time he was seized with a convulsive paroxysm of the head and shoulders; this was followed by a flow of automatic speech purporting to emanate from the spirit of Mrs. J——, and fully confirming his friends' notions. Upon another occasion he was in a pine wood

at night with them. Certain of the ladies professed to see signs and portents in the skies, and he had a similar convulsive attack followed by speech. This began with the words, "O my people! O my people!" and was of a semiprophetic character. As an illustration of the sort of confirmation thus given, I may quote a passage, spoken automatically September 6, 1894, and purporting to come from Mrs. J——: "I am the mother of the Evangel. There are several things which must be done. S—— (Miss J——) must go to the house of the man she got the things from on the day of the coming of the man from the other side of the water. Also tell her that she must tell the man that the work is to be of the kind he said he would help on. And tell her that I say that she must go to him and say that I am the one that sent her to him; and also say that the whole world is now ready for the coming of the day when the coming of the truth shall enlarge the whole possibilities of the race. You may also say that I said that he was the man that the whole of the thing on the day of the fate had to be turned to. Say that I am now with the man whom I shall go with in the spirit to direct him," etc.

Mr. Le Baron had heard of "speaking with tongues," and, believing as he did in transmigration, naturally inferred that he "must have some dead languages lurking away somewhere in the nooks and crannies of his much-experienced soul." Hence, not long after the invasion, his utterances assumed this character. They were poured forth very rapidly in deep, harsh, loud tones, coming apparently from the abdomen; often, he told me, "it seemed as if the malignity of a city were concentrated into a word," and many persons found the sound most startling. In an affidavit made February 2, 1895, he swore that "since the first day of September, 1894, he has experienced an automatic flow of foreign speech the meaning of which he does not understand when he utters it; that he is not a professed medium, and makes no claim to any supernatural or supernormal claims for the same; that he can utter by the command of his will this automatic flow of foreign consonantal and vowel combinations at any place and time to any length; and that the aforesaid automatic flow often assumes other linguistic forms than the following."

One or two illustrations of the "unknown tongues," in prose and verse, must suffice: "Shurumo te mote Cimbale. Ilunu teme tele telunu. Onstomo te ongorolo. Sinkete ontomo. Īsa bulu, bulu, bulu. Ecemete compo tete. Olu mete compo. Lete me lu. Sine mete compote. Este mute, pute. Ompe rete keta. Onseling eme ombo lu mu. Outeme mo, mo, mo. Ebedebede tinketo. Imbe, Imbe, Imbe."

"Ede pelute kondo nadode
Igla tepete compto pele

Impe odode inguru lalele
Omdo resene okoro pododo
Igme odkondo nefulu kelala
Nene pokonto ce folodelu
Impete la la feme olele
Igdepe kindo raog japate
Relepo oddo og cene lumano."

After the utterance in a "tongue" a "translation" was usually given in the same way, and the "translation" of the above poem, although somewhat incoherent, is of a distinctly higher order than most of the prose utterances. Witness one stanza:

"The coming of man from the roar of the ages
Has been like the seas in the breath of the storm ;
His heart has been torn and his soul has been riven,
His joy has been short and his curse has been long.
But the bow of my promise still spreads in the heavens ;
I have not destroyed the great sign of my love.
I stand at the door of the ark of creation,
And take in thy world like a storm-beaten dove,
And press to my bosom the world that I love."

Mr. Le Baron has shown traces of sensory automatism, but very seldom. Once, in a sleeper returning from Chicago, he was awakened by a voice in his ears saying, "Enthusiasm shall fill the hearts of the multitude in the place of the hours of the day." He has also seen flashes of light.

As an illustration of automatic "prophecy" I may quote the following: "I have heard the wail of the dying and I have heard the wail of the man whose heart was broken. I have heard the voice of mirth and I have heard the voice of woe. I have heard the voice of him who is darkness and I have heard the voice of him who is light. I have heard the roar of the ocean and I have heard the song of the bird. I have heard the triumph of peace and I have heard the triumph of woe. I have heard the tears of the nations as they fell and I have heard the songs of the nations as they rose. I have heard the roar of cities and I have heard the music of the woodlands. I have heard the roar of the death of the man who was slain in battle and I have heard the shout of the victor. I have heard the new word and I have heard the old word," etc.

Mr. Le Baron never publicly admitted any belief in the veridical character of these utterances. As he says himself: "All this involved such an unscientific view of things, and was, moreover, so horribly egotistic and full of 'gall,' impudence, and assumption, that I said nothing about it save to the few who had been throwing fuel upon the fire of my reincarnation conceptions and who were ready to believe anything in support of the hypothesis."

Yet he was much impressed, as he frankly owns: "I, for the time being and for months afterward, assented to the statement of my subliminal that my soul had pre-existed; I also believed that it knew when and where it had pre-existed. When it therefore stated that I had been sent through the fires of three thousand years of awful transmigration because, as Rameses or Sesostris, my way had not been 'the way of the Lord,' I either had to assent to the inference that my subliminal was a liar, or that it told the truth, or that it was mistaken. As it insisted upon pouring into my upper consciousness the loftiest of spiritual advice, I concluded that, if it was such a pure teacher of love and justice, it would make no mistake *knowingly* about a matter of history." Yet he never lost sight of the fundamental point—that, without verification, his automatic utterances were worthless, and he deliberately set himself the task of verifying or disproving them. He sought the advice of linguists and toiled through many a grammar and lexicon of little known languages with a purely negative result. The languages proved to be nothing more than meaningless combinations of sounds, and the supposed lofty communications from the Almighty were found to be the scarcely more intelligent reflection of the ideas with which the air was surcharged. As he himself jokingly phrased it in conversation, "I was like a cat chasing her own tail." I can not do better, in concluding my account of this case, than quote Mr. Myers's comment upon it: * "He had the good fortune to meet with a wise and gentle adviser,† and the phenomenon which, if differently treated, might have led on to the delusion of many, and perhaps to the insanity of one, became to the one a harmless experience, and to the world an acquisition of interesting psychological truth."

The only other outbreak of automatic speech of which any considerable details have been preserved was that which took place among the followers of the Rev. Edward Irving at the close of the first third of the present century. I have not been able to get access to all the extant information about this outbreak, but there can be little doubt that it was precisely analogous to Mr. Le Baron's experience. The "unknown tongues" were usually followed by a "translation," and all witnesses describe them as uttered in strange and unnatural tones. One witness speaks of them as "bursting forth, and that from the lips of a woman, with an astonishing and terrible crash." Says another, "The utterance was so loud that I put my handkerchief to my mouth to stop the sound, that I might not alarm the house." Another: "There was indeed in the strange, unearthly sound an extraor-

* Journal of the Society for Psychical Research, vol. vii, p. 250.

† Mr. Myers has Prof. James in mind.

dinary power of voice, enough to appall the heart of the most stout-hearted." Of its subjective side we have a vivid description from the pen of Robert Baxter, who was for a while one of Irving's leading prophets, but afterward, finding that the prophecies which his mouth uttered did not come true, he ascribed them to "lying spirits." He thus describes his own original experience:

"After one or two brethren had read and prayed, Mr. T—— was made to speak two or three words very distinctly and with an energy and depth of tone which seemed to me extraordinary, and fell upon me as a supernatural utterance which I ascribed to the power of God. The words were in a tongue I did not understand. In a few minutes Miss E. C—— broke out in an utterance in English which, as to matter and manner and the influence it had upon me, I at once bowed to as the utterance of the Spirit of God. Those who have heard the powerful and commanding utterance need no description; but they who have not, may conceive what an unnatural and unaccustomed tone of voice, an intense and riveting power of expression, with the declaration of a cutting rebuke to all who were present, and applicable to my own state of mind in particular, would effect upon me and upon others who were come together expecting to hear the voice of the Spirit of God. In the midst of the feeling of awe and reverence which this produced I was myself seized upon by the power, and in much struggling against it was made to cry out and myself to give forth a confession of my own sin in the matter for which we were rebuked. . . . I was overwhelmed by this occurrence. . . . There was in me at the time of the utterance very great excitement, and yet I was distinctly conscious of a power acting upon me beyond the mere power of excitement. So distinct was the power from the excitement that in all my trouble and doubt about it I never could attribute the whole to excitement. . . . In the utterances of the power which subsequently occurred many were accompanied by the flashing in of conviction upon my mind, like lightning rooting itself in the earth; while other utterances, not being so accompanied, only acted in the way of an authoritative communication." At another time he was reading the Bible. "As I read, the power came upon me and I was made to read in the power, my voice raised far beyond its natural pitch, and with constrained repetition of parts and with the same inward uplifting which at the presence of the power I had always before experienced."

So far as I know, there exists no written record of the "tongues" spoken by the Irvingites, but the few specimens of their "prophecies" which I have seen present identically the same characteristics as those found in Mr. Le Baron's utterances

—the same paucity of ideas, the same tendency to hover about one word or phrase with senseless repetitions. One illustration will serve, *ex uno discite omnia:*

"Ah, will ye despise, will ye despise the blood of Jesus? Will ye pass by the cross, the cross of Jesus? Oh! oh! oh! will ye crucify the Lord of glory? Will ye put him to an open shame? He died, he died, he died for you. He died for you. Believe ye, believe ye the Lamb of God. Oh, he was slain, he was slain, and he hath redeemed you; he hath redeemed you; he hath redeemed you with his blood! Oh, the blood, the blood, the blood that speaketh better things than the blood of Abel—which crieth mercy for you now, mercy for you now! Despise not his love, despise not his love, despise not his love!

"Oh, grieve him not! Oh, grieve not your Father! Rest in his love. Oh, rejoice in your Father's love! Oh, rejoice in the love of Jesus, in the love of Jesus, in the love of Jesus, for it passeth knowledge! Oh, the length! oh, the breadth! oh, the height! oh, the depth, of the love of Jesus! Oh, it passeth knowledge! Oh, rejoice in the love of Jesus! O sinner, for what, for what—what, O sinner, what can separate, can separate, can separate from the love of Jesus?" etc.

Mr. Le Baron's "tongues" are constructed upon the same general principle, one phonetic element appearing to serve as the basis or core for a long series of syllables. I believe all these cases to be analogous to that of my friend B——, and I see no reason for ascribing them to subconscious activities of any kind.

THE GENIUS AND HIS ENVIRONMENT.

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III.

WITH this outcome, we may return to the genius. And the first requirement is that we state the social man in the fewest terms, in order that we may then judge the genius with reference to the sane social man, the normal *socius*. What he is we have seen. He is a person *who learns to judge by the judgments of society*. What, then, shall we say of the genius from this point of view? Can the hero-worshiper be right in saying that the genius teaches society to judge; or shall we say that the genius, like other men, must learn to judge by the judgments of society?

The most fruitful point of view is, no doubt, that which considers the genius a variation. And unless we do this it is evidently impossible to get any theory which will bring him into

our general scheme. But how great a variation? and in what directions?—these are the questions. The great variations found in the criminal by heredity, the insane, the idiotic, etc., we have found excluded from society; so we may well ask why the genius is not excluded also. If our determination of the limits within which society decides who is to be excluded is correct, then the genius must come within these limits. He can not escape them and live socially.

The directions in which the genius actually varies from the average man are evident as a matter of fact. He is, first of all, a man of great power of thought, of great constructive imagination, as the psychologists would say. So let us believe, first, that a genius is a man who has, occasionally, greater thoughts than other men have. Is this a reason for excluding him from society? Certainly not; for by great thoughts we mean true thoughts, thoughts which will work, thoughts which bring in a new era of discovery of principles, or of their application. This is just what all development depends upon, this attainment of novelty, which is consistent with older knowledge and supplementary to it. But suppose a man have thoughts which are not true, which do not fit the topic of their application, which contradict established knowledges, or which result in bizarre and fanciful combinations of them; to that man we deny the name genius: he is a crank, an agitator, an anarchist, or what not. The test, then, which we bring to bear upon the intellectual variations which men show is that of truth, practical workability—in short, to sum it up, "fitness." Any thought, to live and germinate, must be a fit thought. And the community's sense of the fitness of the thought is their rule of judgment.

Now, the way the community got this sense—that is the great result we have reached above. Their sense of fitness is just what I called above their judgment. As far, at least, as it relates to matters of social import, it is of social origin. It reflects the outcome of all social heredity, tradition, education. The sense of social truth is their criterion of social thoughts, and unless the social reformer's thought be in some way fit to go into the setting thus made by earlier social development, he is not a genius but a crank.

I may best show the meaning of the claim that society makes upon the genius by asking in how far in actual life he manages to escape this account of himself to society. The facts are very plain, and this is the class of facts which writers like Mr. Spencer urge, as supplying an adequate rule for the application of the principles of their social philosophy. The simple fact is, say they, that without the consent of society the thoughts of your hero, whether he be genius or fool, are practically valueless. The full-

ness of time must come; and the genius before his time can not be, if judged by his works, a genius at all. His thought may be great, so great that, centuries after, society may attain to it as its richest outcome and its profoundest intuition, but before that time it is as bizarre as the madman's fancies and as useless. What would be thought, we might be asked, of a rat which developed upon its side the hand of a man, with all its exquisite mechanism of bone, muscle, tactile sensibility, and power of delicate manipulation, if the remainder of the creature were true to the pattern of a rat? Would not the rest of the rat tribe be justified in leaving this anomaly behind to starve in the hole where his singular appendage held him fast? Is such a rat any the less a monster because man finds use for his hands?

To a certain extent this argument is true and forcible. If social utility be our rule of definition, then certainly the premature genius is no genius. And this rule of definition may be put in another way which renders it still more plausible. The variations which occur in intellectual endowment in a community vary about a mean; there is theoretically an average man. And the differences among men which can be accounted for by any philosophy of life must be in some way referable to this mean. Variations which do not meet their counterpart at all in the social environment, but which strike all the social fellows with disapproval, finding no sympathy whatever, are thereby exposed to the charge of being "sports" of Nature and the fruit of chance. The lack of hearing which such a man gets sets him in a form of isolation which stamps him not only as the social crank but also as the cosmic tramp.

Put in its positive and usual form this view simply claims that man is always the outcome of the social movement. The reception he gets is the measure of the degree in which he adequately represents this movement. Certain variations are possible—men who are forward in the legitimate progress of society—and these men are the true and only geniuses. Other variations, which attempt to discount the future, are sports; for the only permanent discounting of the future is that which is projected from the elevation of the past.

The great defect of this view is found in its definitions. We exclaim at once: Who made the past the measure of the future? And who made social approval the measure of truth? What is there to eclipse the vision of the poet, the inventor, the seer, that he should not see over the heads of his generation, and raise his voice for that which to all men else lies behind the veil? The social philosophy of the school of Spencer can not answer these questions, I think; nor can it meet the appeal we all make to history when we cite the names of Aristotle, Pascal, and Newton,

or of any of the men who have single-handed and alone set guide-posts to history, and given the world large portions of its heritage of truth. What can set limit to the possible variations of fruitful intellectual power? Rare such variations—that is their law: the greater the variation, the more rare! But so is genius: the greater, the more rare. And as to the rat with the human hand, he would not be left to starve and decay in his hole; he would be put in alcohol when he died, and kept in a museum! And the lesson which he would teach to the wise biologist would be that here, in this rat, Nature had shown her genius by discounting in advance the slow processes of evolution.

It is indeed the force of such considerations as these which has led to many justifications of the position that the genius is quite out of connection with the social movement of his time. Prof. William James, for instance, in a most vivid and interesting article in the Atlantic Monthly, October, 1888, brings out the implications of the doctrine of variations very clearly, and bases upon it the further position that the causes which enter into the production of variations in the heredity of the individual are altogether physiological, and so represent a complete "cycle," apart from the other "cycle" of causes found in the physical and social environment of the individual. So that the individual brings his variations to his society whether society will or not; and as to whether there be any harmony between him and his social fellows—that is a matter of outcome rather than of expectation or theory.

But this is not tenable, as we have reason to think, from the interaction which actually takes place between the two so-called "cycles" of causation. To be sure, the heredity of the individual is a physiological matter, in the sense that the son must inherit from his parents and their ancestors alone. But granted that two certain parents are his parents, we may ask how these two certain parents came to be his parents. How did his father come to marry his mother, and the reverse? This is distinctly a social question; and to its solution all the currents of social influence and suggestion contribute. Who is free from social considerations in selecting his wife? Does the coachman have an equal chance to get the heiress, or the blacksmith the clergyman's daughter? Do we find inroads made in Newport society by the ranchman and the dry-goods clerk? And are not the inroads which we do find, the inroads made by the dukes and the marquises, due to influences which are quite social and psychological? And, on the other hand, what leads the duke and the marquis to lay their titles at Newport doors, while the ranchman and the dry-goods clerk keep away, but the ability of both these types of suitors to estimate their chances just on social and psychological

grounds? Novelists have rung the changes on this intrusion of the social into the physiological cycle. What is Bourget's Cosmopolis but a picture of the influence of social race characteristics on natural heredity, with the reaction of natural heredity again upon new social conditions?

A speech of a character of Balzac's is to the point, as illustrating a certain appreciation of these social considerations which we all to a degree entertain. The Duchesse de Carigliano says to Madame de Sommervieux: "I know the world too well, my dear, to abandon myself to the discretion of a too superior man. You should know that one may allow them to court one, but marry them—that is a mistake! Never—no, no. It is like wanting to find pleasure in inspecting the machinery of the opera instead of sitting in a box to enjoy its brilliant illusions." To be sure, we do not generally deliberate in this wise when we fall in love: but that is not necessary, since our social *milieu* sets the style by the kind of intangible deliberation which I have called judgment and fitness. Suppose a large number of Northern advocates of social equality should migrate to the Southern States, and, true to their theory, intermarry with the blacks. Would it not then be true that a social consideration had run athwart the physiological "cycle," in the production of a legitimate mulatto society? A whole race might spring from a purely psychological or social initiation. "Sexual selection" is certainly a principle of broad biological application in human affairs.

I agree, however, with the hero-worshiper so far as to say that we can not set the limitations of the genius on the side of variations in intellectual endowment. So, if the general position be true that he is a variation of some kind, we must seek somewhere else for the direction of those peculiar traits whose excess would be his condemnation. This we can only find in connection with the other demand that we make of the ordinary man—i. e., the demand that he be a man of good judgment. And to this we may finally turn.

In approaching this topic it is well to bear in mind a further result which follows from the reciprocal character of social relationships. If the man in question have thoughts which are socially true, he will, *ipso facto, know that they are true.* He is a social outcome as well as are the fellows who sit in judgment on him. He must judge his own thoughts, too, as they do. So his own proper estimate of things and thoughts, his relative sense of fitness, gets application by a direct law of his own mental processes to himself and to his own creations. The limitations which, in the judgment of society, his variations must not overstep, are set by his own judgment also. So we reach the conclusion regarding the intellectual variations which the genius may have:

he and society must agree in regard to the fitness of them, although this agreement is not the emphatic thing. The essential thing in this matter of intellectual variation is that the thoughts thought must always be critically judged by the thinker himself. This may be illustrated in some detail.

Suppose we take the man of striking thoughts and with them no sense of fitness—none of the judgment about them which society has. He will go through a mighty host of discoveries every hour. The very eccentricity of his imaginations will only appeal to him for the greater admiration. He will bring his most chimerical schemes out and air them with the same assurance that the real inventor exhibits his; but such a man is not pronounced a genius. If his ravings about this and that are harmless, we smile and let him talk; but if his lack of judgment extend to things of grave import, or be accompanied by equal illusions respecting himself and society in other relations, then we classify his case and put him into the proper ward for the insane. Two of the commonest forms of such impairment of judgment are seen in the victims of persecution on the one hand, the *exaltés* on the other. The images which throng into the consciousness of the former of these are those which represent his own powerlessness before an ever-present enemy. Neither the assurances of friends nor the evidence of his own senses are sufficient to rectify the judgment he makes that these imaginings are real. He has no true sense of values, no way of selecting the fit combinations of his fancy from the unfit; and even though some transcendently true and original thoughts were to flit through his diseased imagination, they would go as they came, and the world would still wait for a genius to arise and rediscover them. The other class—the *exaltés*—are somewhat the reverse. The illusion of personal greatness is so strong that their thoughts are infallible and their persons divine.

Men of such perversions of judgment are common among us. We all know the man who seems to be full of rich and varied thoughts, who holds us sometimes by the extraordinary power of his conceptions or the beauty of his creations. And yet we find in it all some incongruity, some eminently unfit element, some grotesque application, some elevation or depression from the level of commonplace truth, some ugly strain in the æsthetic impression. The man himself does not know it, and that is the reason that he includes it. His sense of fitness is dwarfed or paralyzed. We in the community learn to regret that he is so "visionary," with all his talent, and so we accommodate ourselves to his unfruitfulness, and at the best only expect an occasional hour's entertainment under the spell of his thinking. This certainly is not the man to produce world movements.

Most of the men we call "cranks" are of this type. They are essentially lacking in judgment, and the popular estimate of them is exactly right.

It is evident, therefore, from this last explanation, that there is a second direction of variation among men—a variation in their sense of the truth and value of their own thoughts, and with them of the thoughts of others. This is the second limitation which the man of genius shares with men generally—the limitation in the amount of variation which he may show in his social judgments, especially as these variations affect the claim which he makes upon society for recognition. It is evident that this must be an interesting and important factor in our estimate of the claims of the hero to our worship, especially since it is the more obscure side of his temperament, and the side generally overlooked altogether. I shall therefore devote the rest of my space to the attempt to illustrate this matter of what I shall call the "social sanity" of the man of genius.

IV.

The first indication of the kind of social variation which oversteps even the degree of indulgence society is willing to accord to the great thinker, is to be found in the effect which education has upon character. The discipline of social development is, as we have seen, mainly conducive to the reduction of eccentricities, the leveling off of personal peculiarities. All who come into the social heritage learn the same great series of lessons derived from the past, and all get the sort of judgment required in social life from the common exercises of the home and school in the formative years of their education. So we should expect that the greater singularities of disposition which represent insuperable difficulty in the process of social assimilation would show themselves early. Here it is that the actual conflict comes—the struggle between impulse and social restraint. Many a genius owes the redemption of his intellectual gifts to legitimate social uses to the victory gained by a teacher and the discipline learned through obedience. And thus it is, also, that so many who give promise of great distinction in early life fail to achieve it. They run off after a phantom, and society pronounces them mad. In their case the personal factor has overcome the social factor; they have failed in the lessons they should have learned, their own self-criticism is undisciplined, and they miss the mark.

These two extremes of variation, however, do not exhaust the case. One of them tends in a measure to the blurring of the light of genius, and the other to the rejection of social restraint to a degree which makes the potential genius over into a crank. The average man is the mean. But the greatest reach of human at-

tainment, and with it the greatest influence ever attained by man, is yet more than any one of these. It is not enough, the hero-worshiper may still say, that the genius should have sane and healthy judgment, as society reckons sanity. The fact still remains that even in his social judgments he may instruct society. He may stand alone and, by sheer might, lift his fellow-men up to his point of vantage, to their eternal gain and to his eternal praise. Even let it be that he must have self-criticism, the sense of fitness you speak of, that very sense may transcend the vulgar judgment of his fellows. His judgment may be saner than theirs; and as his intellectual creations are great and unique, so may his sense of their truth be full and unique. Wagner led the musical world by his single-voiced praise of the work of Wagner; and Darwin had to be true to his sense of truth, to the formulations of his thought, though no man accorded him the right to instruct his generation either in the one or in the other. To be sure, this divine assurance of the man of genius may be counterfeited; the vulgar dreamer often has it. But, nevertheless, when a genius has it, he is not a vulgar dreamer.

This is true, I think, and the explanation of it leads us to the last fruitful application of the doctrine of variations. Just as the intellectual endowment of men may vary within very wide limits, so may the social qualifications of men. There are men who find it their meat to do society service. There are men so naturally born to take the lead in social reform, in executive matters, in organization, in planning our social campaigns for us, that we turn to them as by instinct. They have a kind of insight to which we can only bow. They gain the confidence of men, win the support of women, and excite the acclamations of children. These people are the social geniuses. They seem to anticipate the discipline of social education. They do not need to learn the lessons of the social environment. Their "tact," we say, is great.

Now, such persons undoubtedly represent a variation toward suggestibility of the most delicate and singular kind. They surpass the teachers from whom they learn. It is hard to say that they are "learning to judge by the judgments of society." And yet they differ from the man whose eccentricities forbid him to learn through the discipline of society. The two are opposite extremes of variation; that is the only possible construction of them. It is the difference between the ice-boat which travels faster than the wind, and the skater who braves the wind and battles up-current in it. The latter is soon beaten by the opposition; the former outruns its ally. The crank, the eccentric, the enthusiast—all these run counter to sane social judgment; but the genius leads society to his own point of view, and interprets the social movement, of which he and his fellows are part, so ac-

curately, sympathetically, and with such profound insight that his very singularity is its inspiration.

Now, let a man combine with this insight—this extraordinary sanity of social judgment—the power of great inventive and constructive thought, and then, at last, we have our hero, and one that we well may worship. To great thought he adds balance; to originality, judgment. This is the man to start the world movements, if we want a single man to start them. For, as he thinks profoundly, so he discriminates his thoughts and assigns them values. His fellows judge with him or learn to judge after him, and lend to him the motive force of success—enthusiasm, reward. He may wait for recognition, he may suffer imprisonment, he may be muzzled for thinking his thoughts, he may die, and with him the truth to which he gave but silent birth. But the world comes, by its slower progress, to traverse the path in which he wished to lead it; and if so be that his thought was recorded, the world revives it in regretful sentences on his tomb.

The thing to be emphasized, therefore, on the rational side of the phenomenally great man—I mean on the side of our means of accounting for him in reasonable terms—is the sanity of his judgment; the fact that he has great thoughts being the acknowledged and familiar fact. And the variations from this social sanity give all the ground that various writers have for the one-sided views which are now current in popular literature. We are told, on one hand, that the genius is a "degenerate"; on the other hand, that he is to be classed with those of "insane" temper; and yet again, that his main characteristic is his readiness to outrage society. All these so-called theories rely upon facts—as far as they have any facts to rely upon—which we may readily estimate from our present point of view. As far as a really great man busies himself mainly with things which are objective, unsocial, and morally neutral—such as electricity, natural history, and mechanical theory with its applications—of course, the mental capacity which he possesses is the main thing, and his absorption in this may lead to a warped sense of the more ideal and refined relationships which are had in view by the writer in quest for degeneracy. It will still be admitted, however, by those who are conversant with the history of science, that the greatest scientific geniuses have been men of profound quietness of life and normal social development. It is to the literary and artistic genius that the seeker after abnormities has to turn; and in this field, again, the facts serve to show their own meaning. As a general rule, these artistic phenomena do not represent the union of variations which we find in the greatest genius. Such men are often distinctly lacking in power of sustained constructive thought. Their insight is largely what is called intuitive. They have flashes of

emotional experience which crystallize into single creations of art. They depend upon "inspiration"—a word which is responsible for half the overrating of such men, and for a good many of their illusions. Not that they do not perform great feats in the several spheres in which their several "inspirations" come; but with it all they do present the sort of unbalance and fragmentary intellectual endowment which allies them, in particular instances, to the classes of persons whom the theories I am discussing have in view. It is only to be expected that the kind of sharp jutting variation in the emotional and æsthetic realm which the great artist often shows should carry with it irregularities in heredity in other respects.

Besides, the very habit of this kind of genius, the habit of living by inspiration, puts a premium upon any half-hidden peculiarities which he may have, both in the remark of his associates and in the conduct of his own social duties. He gets to be considered the social exception, the anomaly, the man to be indulged; and his own sense of the greatness and peculiarity of his gifts leads him to claim the indulgence. I honestly think that a due imposition of certain social penalties upon men like Byron in the crises of their existence would at once have purified their lives and dignified their art; while at the same time it would have removed some of the best examples of Nordau and the rest, and suppressed the stimulus to the same kind of social deformity in later men of talent. Mark you, I do not discredit the superb art of these examples of the literary and artistic "degenerate"; that would be to make some of the highest ministrations of genius, to us men, random and illegitimate, and to deny to humanity some of its most exalting and intoxicating sources of inspiration. But I do still say that wherein such men move and instruct us they are in these spheres above all things sane with our own sanity, and wherein they are insane they do discredit to the inheritance to which their better gifts make legitimate claim.

One of Balzac's characters again hits the nail on the head. "My dear mother," says Augustine, in the Sign of the Cat and Racket, "you judge superior people too severely. If their ideas were the same as other folks they would not be men of genius."

"Very well," replies Madame Guillaume, "then let men of genius stop at home and not get married. What! A man of genius is to make his wife miserable? And because he is a genius it is all right! Genius! genius! It is not so very clever to say black one minute and white the next, as he does, to interrupt other people, to dance such rigs at home, never to let you know which foot you are to stand on, to compel his wife never to be amused unless my lord is in gay spirits, and to be dull when he is dull."

"But, mother, the very nature of such imaginations!"

"What are such 'imaginations'?" Madame Guillaume went on, interrupting her daughter again. "Fine ones are his, my word! What possesses a man, that all on a sudden, without consulting a doctor, he takes it into his head to eat nothing but vegetables? There, get along! if he were not so grossly immoral, he would be fit to shut up in a lunatic asylum."

"O mother, can you believe?"

"Yes, I do believe. I met him in the Champs-Elysées. He was on horseback. Well, at one minute he was galloping as hard as he could tear, and then pulled up to a walk. I said to myself at that moment, 'There is a man devoid of judgment!'"

The main consideration which this paper aims to present, that of the responsibility of all men, be they great or be they small, to the same standards of social judgment, and to the same philosophical treatment, is illustrated in the very man to whose genius we owe the principle upon which my remarks are based—Charles Darwin; and it is singularly appropriate that we should also find the history of this very principle, that of variations with the correlative principle of selection, furnishing a capital illustration of my inferences. Darwin was, with the single possible exception of Aristotle, the man with the sanest judgment that the human mind has ever brought to the investigation of Nature. He represented, in an exceedingly adequate way, the progress of scientific method up to his day. He was disciplined in all the natural science of his predecessors. His judgment was an epitome of the scientific insight of the ages which culminated then. The time was ripe for just such a great constructive thought as his—ripe, that is, as far as the accumulation of scientific data was concerned. His judgment differed then from the judgment of his scientific contemporaries mainly in that it was sounder and safer than theirs. And with it Darwin was a great constructive thinker. He had the intellectual strength which put the judgment of his time to the strain—everybody's but his own. This is seen in the fact that Darwin was not the first to speculate in the line of his great discovery, nor to reach formulas; but with the others guessing took the place of induction. The formula was an uncriticised thought. The unwillingness of society to embrace the hypothesis was justified by the same lack of evidence which prevented the thinkers themselves from giving it proof. And if no Darwin had appeared, the problem of biological development would have been left about where it had been left by the speculation of the Greek mind. Darwin reached his conclusion by what that other great scientific genius in England, Newton, described as the essential of discovery, "patient

thought"; and having reached it, he had no alternative but to judge it true and pronounce it to the world.

But the fate of the principle of variations with natural selection had the reception which shows that good judgment may rise higher than the level of its own social origin. Even yet the principle of Darwin is but a spreading ferment in many spheres of human thought in which it is destined to bring the same revolution that it has worked in the sciences of organic life. And it was not until other men, who had both authority with the public and information enough to follow Darwin's thought, seconded his judgment, that his great formula began to have currency in scientific circles.

Now I ask, Does not any theory of man which loses sight of the supreme sanity of Darwin, and with him of Aristotle, and Angelo, and Leonardo, and Newton, and Leibnitz, and Shakespeare, seem weak and paltry? Do not delicacy of sentiment, brilliancy of wit, fineness of rhythmical and æsthetic sense, the beautiful contributions of the talented special performer, sink into something like apologies—something even like profanation of that name to conjure by, the name of genius? And all the more if the profanation is made real by the moral irregularities or the social shortcomings which give some color of justification to the appellation "degenerate." But, on the other hand, why run to the other extreme and make this most supremely human of all men an anomaly, a prodigy, a bolt from the blue, an element of extreme disorder, born to further or to distract the progress of humanity by a chance which no man can estimate? The resources of psychological theory are adequate, as I have endeavored to show, to the construction of a doctrine of society which is based upon the individual, in all the possibilities of variation which his heredity may bring forth, and which yet does not hide or veil those heights of human greatness on which the halo of genius is wont to rest. Let us add knowledge to our surprise in the presence of such a man, and respect to our knowledge, and worship, if you please, to our respect, and with it all we then begin to see that because of him the world is the better place for us to live and work in.

We find that, after all, we may be social philosophers and hero-worshipers as well. And by being philosophers we have made our worship more an act of tribute to human nature. The heathen who bows in apprehension or awe before the image of an unknown god may be rendering all the worship he knows; but the soul that finds its divinity by knowledge and love has communion of another kind. So the worship which many render to the unexplained, the fantastic, the cataclysmal, this is the awe that is born of ignorance. Given a philosophy that brings the

great into touch with the commonplace, that delineates the forces which arise to their greatest grandeur only in a man here and there, that enables us to contrast the best in us with the poverty of him, and then we may do intelligent homage. To know that the greatest men of earth are men who think as I do, but deeper, and see the real as I do, but clearer, who work to the goal that I do, but faster, and serve humanity as I do, but better—that may be an incitement to my humility, but it is also an inspiration to my life.

THE SCALLOP (*Pecten irradians*).

By FRED MATHER.

WHETHER we follow the old spelling of "escalop," the modern form of "scallop," now used by naturalists, or write it "scollop," after the manner of the fishermen, we find all three modes sanctioned by the dictionaries. Near the seacoast this mollusk is a great favorite, rivaling the clam and the oyster, and by many persons preferred to either. The home demand is so great that the "scollop" is not sent far inland, and it is a matter of surprise how little is popularly known of the animal of which a portion is seen in our seaboard markets during the fall and winter months by those who sell and those who eat them.

For many centuries the beautiful form of the scallop shell has been a favorite with artists, who have used it as an ornament in sculpture, pottery, and in designs of many kinds, and it is found on the armorial bearings of families whose ancestors had made a pilgrimage to the Holy Land or to Spain:

> For the scallop shows in a coat of arms
> That, of the bearer's line,
> Some one in former days hath been
> To Santiago's shrine.

The shell is not found on the Atlantic coast of Europe, but is common on the shores of Judea and other parts of the Mediterranean; hence its possession was evidence of the pilgrimage, and the Crusaders always wore the shell on their hats after returning. Fuller says: "The scallop shell (I mean the nethermost of them, because most concave and most capacious) was often the cup and dish to the pilgrims in Palestine; their arms they always charged therewith." The delicate shell has commended itself to makers of toilet and other articles for ladies' use, such as pincushions, made either in one valve or between both shells; needlebooks and many other things are made from them, but they are too frail for some uses that shells have been put to, such as scrapers, scoops, and dishes, yet from their employment by cooks to serve a peculiar

patty of oysters in, they have given the name of "scolloped oysters" to the dish, whether served in the shells or otherwise.

The only portion of this handsome bivalve that is edible is the adductor muscle, which closes the shells and corresponds to the "hard part" in the oyster, often miscalled the "eye"; the rest of the animal, being very soft, is called the rim by the fishermen. The little village of New Suffolk, on Great Peconic Bay, which divides the eastern end of Long Island into two long peninsulas, lives mainly from the scallop fisheries, which begin in September and end about the first of May, and are only interfered with by the freezing of the bay or by floating ice, for the hardy fishermen seldom mind the weather unless a gale should interfere

Going it alone.

with the management of the boats, which are small sloops of five to fifteen tons burden and are managed by two men—one at the tiller and the other at the dredges. They use from one to six dredges, according to the size of the boat. The scallop fleet of New Suffolk comprises twenty-six boats, and some few others of a smaller class occasionally join in the work. About seventy men do the catching and carting, while twenty men, thirty women, and eighty children open and prepare the catch for market; and as the population of the place is only two hundred and seventy-five, it may be truly said that all—grocer, postmaster, and stage driver—live from the catching of scallops. Children stop on the way home from school and open a few quarts, and mothers often rock the cradle with one foot while standing on the other at work in the shops.

Greenport, Sag Harbor, and other places on Long Island do much in this line of work, and tons of scallops come to New York from Rhode Island and other waters east of New York; but the

little hamlet of New Suffolk was selected to get information and pictures from, because the place has very little else to live upon, and the very air is impregnated with scallops, as you will find if you get to leeward of the great heaps of shells in rear of the shops,

LIGHT WIND, ONLY FOUR DREDGES OUT.

and no stretch of imagination could suggest that the odors came from the spice islands or were wafted from "Araby the blest." Fortunately, the shops are situated where the smell does not offend the noses of the people in the town, and is gone by the time that the few summer visitors arrive. There is a good hotel here—the Grant House—kept by a man well known in Brooklyn as a caterer, and a few families come to this quiet spot for the summer, while sportsmen fond of duck-shooting gather there in the fall. The fame of the fried scallops at the Grant House extends farther than the flavor of the shells. I was fortunate in securing the services of Captain George W. King, who has dragged the scallop from its lair for the past twenty years, and most of my information comes from him that is not taken from my investigations for the United States Fish Commission in 1880. Opposite New Suffolk is Robbins Island, where the famous club of that name turns out thousands of quail and other game yearly, for their fall shooting.

The dredge is similar to that used for oysters, consisting of an iron frame about three feet long by half as high, to which the

bag is fastened; the latter, holding a bushel and a half, is made of chain where it drags the bottom, and of twine on the top portion. The dredges are used in from three to thirty feet of water from the windward side of the boat, with a length of line varying with the depth and also with the speed, the line being shortened when the wind is light, to prevent anchoring the boat, and if the wind is very light the number of the dredges must be lessened. After sailing a certain distance the dredges are brought in one by one and dumped on the culling board, where the contents are assorted; the small crabs are thrown overboard, the winkles and

Bringing a Dredge on Board.

starfish thrown one side for fertilizers, and the scallops shoveled into the hold. Thirty bushels a day is a fair catch for a boat, while fifty bushels is considered to be a good day's work.

Two other species are found on our Atlantic coast, both rare south of Cape Cod, one of which is common on the coast of Maine, is extensively fished for, and is very large. The species now under

consideration is rare north of Cape Cod and extends as far south as the Gulf of Mexico. In summer it is found among the eel-grass, where it breeds, and in the autumn comes into the shallow waters to feed. It moves by swimming in a dancing manner by suddenly closing its shells and ejecting the water and then taking in more. This is a beautiful sight in an aquarium, where they dance about like castanets played by an invisible hand. They are often seen in great schools, moving along, and when the tide is with them they sometimes go half a mile before dropping to the bottom. The scallop can see quite well, being furnished with a row of thirty or more beautiful blue eyes in the outer edge of the mantle of each side, the eyes increasing in number with the growth of the animal. This mantle is the "rim" of the fisherman, and, with the gills and a very flabby stomach, is about all of the scallop, except the great adductor muscle before mentioned. This muscle leaves no mark in the shells, such as is seen in the shells of the oyster and quahaug or hard clam. The shells of the scallop are unequal, the lower one being more convex and lighter in color than the other, and in opening them the dark side is held uppermost by a right-handed man, because it brings the "meat," which is not in the center, in the proper place for speedy work; a left-handed person, of course, requires the deep white side up. The openers, or "shuckers" as they would be called in Baltimore and the South, stand in a row in front of the benches, and drop the shells through a hole into a barrel, toss the meats in a square box holding two quarts, and the rims into another place, and they become very expert at this in time. Men and women open from fifteen to eighteen gallons a day, and children often open three or four gallons after school. Formerly the price paid for this work was twenty-five cents per gallon for all, but of late years the price has dropped with the market price of the meats to sixteen cents for large and twenty-five for small ones. In November, 1894, the shippers only got sixty-five cents a gallon from the market men and many stopped fishing, and the season of 1895 was no better, the fishermen attributing the failure to dredging late in the spring when the seed of the year was marketed in order to get high prices. They open two quarts to the bushel of shells and vary in size from eighty to three hundred and twenty to the quart; a gallon will weigh about eight pounds. Fifteen years ago fifty thousand bushels of shells were sold to oyster planters for catching spat, at two and a half cents per bushel; now the shells sell at six cents per bushel, and in some shops the rims are left with the shells. The shell of the scallop is excellent for catching oyster spat, because it is so fragile that it goes to pieces before the oysters begin to crowd and deform each other, as is the case where many set on a hard shell like that of the oyster.

In New York markets Rhode Island scallops have a reputation for excellence that may or may not be deserved, for in that city "Oyster Bay asparagus" is a label put on almost all bunches of that vegetable as soon as the product of New Jersey arrives; all small hard clams are "Little Necks," although that part of Long Island does not market over fifty thousand bushels in a year, and the quality of tenderness and flavor varies as it does

THE CULLING BOARD.

with "Blue Point" oysters, a term now used for most small oysters, as "Saddle Rock" is for large ones, although no oysters have been taken from that rock in twenty years. So much for a reputation; but the expert housewife looks the different lots of scallops over, passes by the white ones, and buys those of a yellow tint. The fact is that the meat of the scallop is naturally a faint yellow, but soaking whitens and injures it. This soaking in fresh water is done to make them swell and measure more, and it increases their bulk by about a third until the frying-pan has

done its work, when they will be found to have shrunken to less than the original size; hence it is best to avoid the white meats if possible. It is probable that the price for the unwatered scallops would be better if all shippers would agree to stop the practice, and then all scallops would be "Rhode Islands," although market men say that some from that State are watered. The practice is a bad one, because it injures the sale of the meats, as may be seen by comparing the prices in the markets. The scallop is never shipped alive in the shell, because it breaks easily

Loading a Wagon.

and does not live more than a day or two out of the water; besides, being so bulky, the freight would be higher.

Fried with bacon is the most popular way this mollusk is served, although it is occasionally broiled or stewed, and in New York restaurants the order, "Fry, half and half," is often given, which means oysters and scallops, or it is sometimes "A fry, half scallops," for "a fry" is supposed to mean oysters alone. It is only some forty years since the scallop has been known in the markets and became an object of pursuit by the fishermen. Dr. De Kay, although living at Oyster Bay, on Long Island, knew little of it as food, for in his Mollusca, Part V, Zoölogy of New York, 1843, he says: "It abounds on shallow sandy bottoms and is taken in great quantities for food, the broad and stout muscular portion being the only part of the animal used. This is boiled and put in vinegar, and considered by many as a great

delicacy." The "great quantities" in those days meant a few hundred bushels, eaten by the dwellers on Long Island bays, for at that time there was no market for them. The rich, sweet taste of the scallop is disagreeable to a few persons and has been known to produce nausea at times, but to many its tenderness and pronounced flavor are more agreeable than those of any other bivalve.

An old legend claims that the scallop shell rightfully belonged, as a badge, not to the Crusaders and pilgrims to the Holy Land, but only to such as had made the pilgrimage to the celebrated shrine of St. James at Campostella, in Spain, as may be learned from the following account of a miracle:

"The ship in which the body of St. James was conveyed to its last resting place happening to draw near the coast during the performance of certain nuptial festivities, the bridegroom's horse, becoming ungovernable, plunged into the sea and together with its rider sank; but, at the moment the ship was passing by, rose again, close alongside of it. There were several miracles in this case. The first was, that the sea bore upon its waves the horse and horseman as if it had been firm land, after not having drowned them when they were so long under water. The second was, that the wind, which was driving the ship at full speed into port, suddenly fell and left it motionless; while the third and most remarkable was that both the garments of the knight and the trappings of his horse came out of the sea covered with scallop shells, which were afterward enjoined to be worn in commemoration of the event." If such a miracle should happen at New Suffolk to-day the judgment of the inhabitants would be like that in the historical eel case—the scallops would be sent to the shops, and the horse and its rider would be "set again."

Like all marine shells, our scallop is not as clean on the outside when it comes from the water as it appears after preparation for ornamental use. Many forms of animal and vegetable life have attached to it and made their homes upon it, especially on the upper or flatter valve. Here we find the red boring sponge which eats pinholes in all shells, inhabited or not, cutting through to the lining of nacre and occasionally through that to the interior. This injury is promptly repaired from the inside, but small elevations remain to show where the breach was healed. Tube worms build their twisted houses in such masses as to impede the movements of the scallop, and they have been known to bind several individuals together in a mass by their calcareous tubes while the mollusks were lying quiescent, a fact which seems to show that at some seasons the scallop must remain in one place for some time, long enough for the tube worms (*Serpula contortuplicata*) to grow and build their dwellings as increase of size

demands. Probably fair-sized colonies on two contiguous shells may not require many days in the growing season to unite in those shelly knots that may be broken but can never be untied.

THE SHOPS AND SHELLS.

Oysters, "jingles," and "deckers" * set on the shell and grow and impede its progress until it wearies of life and dies.

While on the subject of the shells of this animal it may be worthy to note that in addition to their acrobatic efforts to regain the water when left on shore by the tide, some of the old writers credited them with the sailing powers of the nautilus or "Portuguese man-of-war," and have asserted that, "by flapping their valves with a very quick motion, they can rise from their beds in the deep and navigate the surface, having one shell raised and so disposed as to catch the breeze in its concavity, while the other serves as a boat." We know that they can move below the surface, but must draw the line there.

In the month of May, 1895, I found eggs of the scallop well developed in the ovaries of the animal and apparently ripe, as they were extruded with slight pressure, but found no ripe males at the time, and therefore failed to impregnate the eggs. They were transparent and measured eighty to the centimetre, or over

* Jingles and deckers are fishermen's names for *Anomia glabra* and *Crepidula fornicata*, which, like the oyster, attach to shells, stones, etc.

two hundred to the inch. The absorption of water during the time in which they could have been fertilized would have enlarged the eggs, but to what extent is unknown. On June 10th I found microscopic scallops attached to blades of grass and weeds by a byssus, apparently like that of the mussel; they measured about eighteen to the centimetre, something over forty-five to the inch. Lack of circulation killed them in three days, and another lot was collected on June 18th, which were apparently of the same size.* No more were found until August 18th, when the growth was noticeable, the shells measuring about two centimetres, or three quarters of an inch. These last were taken from the bottom, and had lost the threads which had attached them to the grass.

Scallops are generally believed to live but a few years, many of the fishermen limiting them to only two, but this is a difficult matter to determine. They spawn in May in the bays of Long Island, perhaps in June also; the young attach to the eel-grass, and in August will measure three quarters of an inch across the shell. The next year they are about the size of an American silver dollar, and are too small for the use of most persons and for market. They are thrown on the beach at Cold Spring Harbor and along the north shore of Long Island by the winter winds and freeze in great numbers, and a frozen scallop never recovers life, as some mollusks are said to do. In this harbor there is often a good set of scallops on the grass, but their weight usually breaks the grass, and they are drifted out into Long Island Sound to stock other grounds, and it is only once in several years that there is anything like a scallop crop in the harbor, and when the season is called good the local demand takes them all, and none reach the market. The fact that this harbor, and Oyster Bay also, are extensively planted with oysters, would prevent dredging for scallops to any great extent if they were plenty, and the few that are taken are caught by the oystermen in their rowboats. From our present

* After these investigations, and since this article was written, Dr. James L. Kellogg has published similar observations on the scallop in the Report of the U. S. Fish Commissioner for 1893.

observations it seems as if the scallop might be fit for market in the winter after it is two years old, but not before. How long it may live after that it is impossible to say, further than to judge by the age of oysters and other animals that may attach to the shell of the living scallop, and it is more than likely that their attachment may cause its early death. Blackfish (tautog) eat them, the sheepshead crunches them, and they are often taken from the stomach of the cod and other fishes. The starfish, that devourer of all the shell-bearing mollusks and great enemy of the oyster, destroys them from the time the shell begins to form until the limit of growth is attained, and never desists while life is left in this interesting and useful bivalve.

EPIDEMICS OF HYSTERIA.*

By Dr. WILLIAM HIRSCH.

IT is a pretty widespread opinion that nervous diseases, and especially hysteria, have alarmingly increased during the last decades, and that they are about to increase much more. In all civilized countries, we are told, and in every stratum of the population, a weakness of the nervous system manifests itself of which our forefathers had no knowledge. Neurasthenia and hysteria spread wider and wider, like a devastating epidemic, attacking not merely the lower classes but just the "upper ten thousand." It is educated society which is threatened with total overthrow by utter derangement of the nerves. "Whither is this to lead, and how is it to end?" lament some solicitous prophets who already see yawning before them the gulf by which the enervated human race is about to be swallowed up.

Let us weigh the reasons which occasion this apprehension. What real proof is there of this enormous increase of nervous diseases and of the continually progressive degeneration of civilized man? First of all, there are the statistics. "Numbers," we have been told, "can not lie." Perhaps not; but those who collect them may fasten upon them very seriously mistaken labels.

The assiduous statistician ascertains that the insane asylums contain more women than men. So far, so good. But if he tells us that more women are insane than men, he labels those numbers erroneously, for the inequality is really due to the fact that insane males die off, while insane females survive, relatively speaking. Suppose the statistics of different countries do show that the number of inmates of insane asylums is increasing out

* From Genius and Degeneration. In press of D. Appleton & Co.

of all proportion to the growth of the general population, would it not be superficial in the extreme to conclude, without further data, that insanity was on the increase? At present these statistics mean nothing more than that the number of patients in such institutions has considerably increased. But when we consider what great advances have been made in the diagnosis of mental diseases, and consider also that a great number of such cases, which were formerly treated unsuccessfully at home, are now treated in such institutions with good results, because there they are removed from the detrimental influences of familiar surroundings, while the proper means and methods for rational treatment are at hand, we shall find that the seemingly enormous increase of mental disturbances need not cause us uneasiness.

Other extensive statistical material for nervous diseases is afforded by the numerous dispensaries of the great cities; but no extended experience is required to teach that a large proportion of such cases would not appear if the patients had to pay fixed fees, and round ones, as they had to do in the good old times when physicians saw comparatively little of nervous diseases. Our grandmothers had their "headaches" and their "twitchings in the limbs" like the women of to-day; but they never dreamed of calling a doctor or going to the dispensary for such things, so that they were not "statistical material."

In the dispensaries for nervous diseases there are numerous chronical patients who, becoming discouraged in one place, think they would like to try another doctor; and some of them make a round of sojourns in different hospitals. Each of them is counted as many times over in the statistics as there are places where he is treated. This perceptibly increases the numbers.

These considerations give some idea, though but a slight one, of the extreme difficulty of making even rough approximate inferences from sanitary statistics. But certain observers tell us that exact enumeration is not required. Hysteria and degeneration of the race stare us, as they aver, daily in the face. In every department of human activity disorders of the nervous system are seen. The very style and methods of the art and literature of the day proclaim a general nervous prostration.

Max Nordau is the protagonist of this widespread opinion. In his eyes, mental degeneration has seized upon the majority of civilized men to such a degree that "the upper strata of urban population" form but a "suffering hospital." The art, the poetry, the fiction, the philosophy of the day present the most manifold embodiments of degeneration and of secular hysteria.

Nordau admits, of course, that degeneration and hysteria have always existed. "But," says he, "they were formerly sporadic and were of no importance for the whole life of society."

In declaring that in former times hysteria was but of sporadic occurrence and attained no importance for the life of society as a whole, Nordau falls into a grave error. Mental diseases, and especially hysteria, have, from the earliest times to the present, exercised a tremendous influence upon the current metaphysical conception of the universe and upon the whole mental development, and that precisely because they not only occurred sporadically, but, as we shall soon see, attacked the masses in the form of epidemics, and so became of the highest significance and importance for the life of society as a whole.

Religious enthusiasm and proneness to the mystic and the occult formed, even in the highest antiquity, an important factor of those degenerate and hysterical individuals who entertained the delusion that they were in communication with good or with bad spirits, and who by that channel influenced the masses not a little. A great number of the priestesses who delivered oracular responses to the Greeks "with strong quaking of their body" were psychopathic subjects undergoing the hysterical convulsions well known to us to-day. Hence epilepsy, which in those days was not discriminated from hysterical cramps, came to be called the *morbus sacer*, or sacred disease. Plutarch, in his description of the Pythian priestess, delineates the typical image of a hysterical subject who, in ecstatic convulsion, stammered unintelligible words, into which the priests injected some sense. But hysteria, with its inclination to religious enthusiasm, was not limited to separate persons. On the contrary, we meet with it among all peoples and in all periods of history; and among all peoples we meet with it in the form of epidemics of various kinds. But never did this disease find a better or more fertile soil in which to thrive than in the middle ages of northern Europe, marked as they were by ignorance and superstition; and, accordingly, we find that epidemics of hysteria then assumed dimensions surpassing those of any similar outbursts in other centuries. A great many fine books have been written about the individual and epidemic crazes of those ages. The French have made particularly careful researches into the matter.

Calmeil describes a great number of hysterical epidemics of different forms. One of the principal eruptions in Germany was demonomania, or *Teufelswahn*. "In the year 1549," says Calmeil, "a delusion called *Vaudoisie* prevailed in Artois, that the devils carried many secretly in the night to the assemblies, where compacts were made with Satan and where carnal intercourse took place. Without knowing how, the participants of the nocturnal meetings found themselves next morning back in their dwellings."

A manifestation equally widespread in Germany was anthro-

pophagy—that is, the delusion that the devil and his worshipers lived on human flesh. Men were believed to live in the neighborhood of Berne and of Lausanne who had given themselves to the devil, and who ate their own children. Hundreds of men were for this stretched on the rack or burned at the stake. Indeed, there were a number of insane persons who thought that they themselves were in league with the devil, and that they slew children.

The bull of Innocent VIII, which appeared in 1484, showed how deep-rooted the devil-delusion was in Germany. Everywhere people talked of how there was a great league with devils whose votaries committed deeds of shame in their assemblies; of how they were under obligation to destroy and consume newborn babes before they were baptized. In one year after the publication of the bull, forty-one women were executed in Burbia because in their nocturnal assemblies they always strangled, boiled, and ate a child. Toward the middle of the sixteenth century there broke out in many places in Germany, especially in convents, epidemic convulsions which exhibited the typical image of *la grande hystérie* and were connected with symptoms of religious delusions and of sexual excitement. Of one convent we read: "It was singular that as soon as one nun had her fit, the others, even in distant parts of the building, would immediately go off into fits as soon as they heard the noise of a person falling. The nuns had no power of will at all; they bit themselves, struck and bit their mates, knocked against one another, and endeavored vehemently to wound strangers. Upon any attempt to control the indecency of their conduct, their tumult and exaltation would become more angry. If they were left to themselves, they would soon come to biting and wounding without seeming to feel the least pain." Such subjects were considered to be bewitched or possessed of the devil. They were treated by exorcisms and conjurations which often increased their sufferings.

Not women alone were attacked by the disease; men were visited in the same way. Gilles de la Tourette gives an account of such an epidemic, according to a description by Hecker. We read: "In Aix-la-Chapelle, in 1574, troops of men and women from Germany were seen laboring under a common madness and displaying in the streets and churches this singular spectacle. With clasped hands, and carried away by an inward compulsion which they could not master, they danced for hours and kept up the spectacle without being abashed by those who were about, until they would fall exhausted to the ground. Then they would complain of their great agony, and would groan as though they were going to die, until people wrapped their abdomen with linen cloths, whereupon they would come to themselves and be free for

a time from their sufferings. The object of this was to dispel the wind which set in after the attack. People often resorted to the simpler method of planting blows of the fist or kicks upon their abdomens. During their dance the subjects had visions. They did not see or hear; but in their imagination they beheld spirits whose names they pronounced, or rather shrieked out, . . . fell snorting to the ground without consciousness, and foamed at the mouth. Then, all at once, they got up and began their dance with frightful wrenchings. In a few months this plague extended from Aix-la-Chapelle as far as the Netherlands." Like the men and women, children were likewise attacked.

A phenomenon often seen to-day in insane asylums is that patients think themselves to be beasts, such as dogs, cats, monkeys, wolves, etc., and behave accordingly. In the middle ages this gave rise to the superstition of the Werewolf. The word is formed from *wolf* and the obsolete word *wer*, in Gothic *vair*, in Latin *vir*, man. Such persons, who during epidemics were sometimes found in great numbers, ran about the woods on all fours, lived and behaved exactly like beasts, fell upon men who might pass by, attacked even riders and vehicles, and stole children and devoured their flesh. Such things were known to the ancients too.

The influence which hysterical subjects exercised upon the whole metaphysics, or view of the universe of those times, was tremendous. While superstition and fanaticism may truly be called the best fertilizers to yield a crop of hysteria—and they have vastly contributed to its extension and large growth—at the same time, hysteria, in its turn, with its astonishing symptoms, far beyond the classificatory powers of those ages, has had the effect of enormously feeding and propagating superstition. In short, the two phenomena, hysteria and superstition, played into one another's hands; each was alternately cause and effect; and between them they called forth that dismal period in which the human mind was loaded with fetters, and postponed for centuries its free possession of its heritage. The author who is capable of saying that before this our time "hysteria only occurred sporadically, and was of no importance for the life of society in general," is not acquainted with the history of insanity and the biography of the human race. In order to pass judgment upon the present times from a psychological point of view, the very first requisite is an acquaintance with times gone by, and a tracing out of the path which has brought our culture to its present height.

Before passing on to the study of the present, let us first ask why and how it was that diseases of the mind took on an epidemic character. Most of those authors who have made hysteria the

subject of deep investigations agree in this: that *suggestibility* (using this word approximately in its psychological sense) is a particular mark of the state of soul of the hysterical.

No doubt hysterical epidemics based upon religion continue even to this day. The last century was by no means poor in such phenomena.

The principal causes of the spread of epidemics of insanity and of the so-called secular hysteria are, then, *suggestibility*, emotionalism, the impulse to mimicry, and the tendency to mysticism.

Secular hysteria has by this time gradually assumed a different character. Belief in the devil and witches has faded quite away. Nowadays phenomena that seem unaccountable are produced in great variety by the hysteria which still subsists, and lead to crazy doctrines and errors, but they are new ones. Spiritualism, which flourished most in the middle part of the century, had such an origin. All those surprising phenomena that in earlier times had been referred to the agency of the devil and of witches were now treated as evidences of spiritual presence, telepathy, etc. Hysteria and religious superstition had formerly communicated each vitality to the other; now hysteria and pseudo-science intensified and propagated one another. The literature to which spiritualism has given rise is perfectly enormous, and forms a pendant to the old books on witchcraft. Scientific men of standing write in our times thick books to discuss the evidences of the most incredible theories about spirits, about veracious dreams, about prophecies, about telepathy, about clairvoyance, about premonitions, etc.

With our present knowledge of hysteria, its causes and symptoms, men of science and all who are enlightened by its teachings are under a positive obligation, which can not be shaken off and must not be shirked, to combat everything which tends to further superstition or to nourish the inclination of the people toward mysticism. Our duty it equally is to set our faces against those pernicious practices which are calculated to favor and augment that fatal symptom of hysteria, a heightened *suggestibility*.

It is suggested in the *Revue Scientifique* that the distinctions made in the laws for the protection of birds between insectivorous and graminivorous birds, and birds of passage and those of the country, are somewhat illogical. All birds eat insects during a part of the year, and the little fruit and grain some of them take is a cheap equivalent for the good they do in the destruction of insects. It is often hard to decide whether a bird belongs to the region or not. All birds are more or less migratory, and their stay in any place is largely governed by conditions of food and weather. Naturalists are often surprised by finding species wintering in the north that they had supposed were far in the south.

SKETCH OF WILLIAM WILLIAMS MATHER.

AMERICA will never cease to benefit from the influence of its Puritan stock. Although the former preponderance in national affairs of New England as a section has disappeared with the widening of our territory, the vigor, the intellect, and the conscience of the settlers at Plymouth and at Boston have been diffused by their restless descendants through every State in the Union.

William Williams Mather came from one of the most celebrated of the Puritan families in America. He was descended from Rev. Richard Mather, who fled to Massachusetts in 1635 to escape persecution for nonconformity. Richard Mather brought four sons to America, from the second of whom, Timothy, was descended the subject of this article. Two other sons, Eleazer and Increase, were born to Richard in this country, and the latter of these was the President of Harvard College from 1688–1701. Cotton Mather, the eminent divine and author, whose misguided zeal was such a strong support to the "witchcraft delusion," was a son of Increase. The paternal grandfather of William, Eleazer Mather, and his grand-uncle, Elisha, were officers of the Connecticut troops in the Revolutionary War. The eldest son of this Eleazer, who bore the same name, was the father of William. He learned the hatter's trade in Norwich and set up a business for himself at Brooklyn, in Windham County, Conn., which he carried on successfully for a number of years. He then traveled for a time in Canada, and returning to Brooklyn married Miss Fanny Williams, whose father, Nathan Williams, was also a soldier of the Revolution. After his marriage he ceased to follow his trade, and kept a temperance hotel, also giving considerable attention to the improvement of worn-out lands. His son William Williams was born in Brooklyn on May 24, 1804.

The Hon. Ivers J. Austin, who wrote the memorial sketch of him for the New England Historic Genealogical Society,* was unable to find any information concerning William's childhood, and very little in regard to his early youth. While still in his teens William formed the purpose of becoming a physician, and went to Providence, R. I., to take up medical studies. There he became much interested in chemistry, and on the occasion of a visit home he brought with him an elaborate piece of chemical apparatus, the cost of which rather astonished and displeased his father. But he so amused and instructed his family by his chemical experiments and explanations that his father became entirely reconciled to this outlay. In 1822 the young man

* It is from this memorial that most of the facts in the present article are derived.

applied for a warrant as a cadet at West Point, which he obtained in the following year. Recommending him for this appointment, the chief judge of Windham County wrote: "He is about eighteen years of age, possessed of much more than common talents and literature. He understands the Latin language, and some of the higher branches of mathematical science, which he acquires with much facility."

He entered the academy in the summer of 1823, and, in common with eight or nine other members of his class, spent one year more than the usual period there, being graduated in 1828. Young Mather was proficient in chemical analysis, especially of ores and minerals, before going to West Point, and in 1826, when Webster's Chemistry was passing through the press, the proof-sheets of a part if not the whole of the work were sent to him by the author for suggestions and corrections. These were furnished by him and were adopted, but Mather's name was not mentioned in the preface of the book among those who had contributed to it, and he expressed to his classmate and memoirist, Austin, his disappointment at the omission. In the fall of that year he entered the second class, thus coming to the studies of chemistry and mineralogy in the curriculum of the academy, Webster's book being used. Cadet Mather at once took the head of the class in these subjects, and easily kept his place to the end of the course. When off duty he explored the hills of the vicinity to collect minerals for his private cabinet and that of the lyceum. The chemical laboratory of the institution was also a place of resort for his leisure hours. During the last year of the course he was an assistant in the laboratory. He seemed to have a special aptitude for science and took great delight in experimenting. Mr. Austin illustrates this tendency by the following account:

"The winter of 1826–'27 was very cold. The ice, floating down to the narrow gorge between the precipitous shores of West Point and the opposite bank, became wedged there and was exceedingly thick. It occurred to Mather that a favorable opportunity was thus offered to ascertain the temperature of the water at the bottom of the river while the surface was covered with ice. After several attempts he succeeded in making a self-registering thermometer, and an apparatus for bringing up a specimen of the water of the lowest depth. A hole was cut through the ice about the middle of the river, and the apparatus, attached to a strong cord, was let down into the water, but the current was so strong that it failed to reach the bottom. With a heavier weight it sank far enough, but the pressure forced the cork into the bottle. The next attempt was successful; water was drawn from below, and its temperature ascertained from the self-registering, compared with that indicated by a detached, thermometer. The result of this experiment,

in which the writer assisted him, is not remembered, but Mather declared that he was satisfied with it. Such was his occupation on one of the coldest days in winter, during the whole of the Saturday afternoon allowed to the corps for recreation."

On graduating he was assigned to the Seventh Infantry with the customary rank of second lieutenant. He remained at West Point as acting assistant instructor of artillery during the summer encampment of 1828, and was then ordered to the School of Practice at Jefferson Barracks, where he remained until April, 1829. From April to the end of June he was on frontier duty at Fort Jessup, La. He was then detailed to serve as acting assistant Professor of Chemistry, Mineralogy, and Geology in the Military Academy, which duty he performed until the summer of 1835. The assistant professors at the academy at that time were usually detailed from recent graduates, and their terms of service rarely exceeded two years. The fact that Lieutenant Mather was retained in that capacity for six years indicates that he was an unusually successful instructor. During the recess of his course of instruction in 1833 he acted as Professor of Geology, with the permission of the War Department, at Wesleyan University, Middletown, Conn., and the following year received the honorary degree of A. M. from this university. In the summer of 1834 he made a geological survey of Windham County, Conn.

Within the first year after his graduation Lieutenant Mather published in the American Journal of Science a paper entitled On the Nonconducting Power of Water with Regard to Heat. While serving as assistant professor at the academy he contributed other papers to the same journal, and wrote a small textbook, Elements of Geology, which was afterward enlarged and passed through several editions. He wrote also an account of the diluvium for the use of the cadets in their study of geology.

On being relieved from duty at the academy he was assigned to topographical service as an assistant to G. W. Featherstonhaugh in a geological examination of the country from Green Bay to Coteau des Prairies. This work occupied him during the latter half of 1835. He made a topographical map of the St. Peter's (Minnesota) River Valley and a report, which his later associate Whittlesey says he refused to present to the "pretentious English geologist in charge of the expedition," but transmitted direct to the United States Government. When this survey was completed he was promoted to a first lieutenancy and sent to join his regiment on frontier duty at Fort Gibson, in Idaho Territory. The following summer he marched into the Choctaw country in command of his company. Feeling that he could now safely adopt the pursuit of science as a profession, he resigned his commission in the army at the end of August, 1836.

When he had been one year at West Point as assistant professor, Lieutenant Mather married his cousin, Miss Emily Maria Baker. By this marriage he had three sons and three daughters.

After leaving the army Mr. Mather was for a short time Professor of Chemistry, Mineralogy, and Geology in the University of Louisiana, but before the close of 1836 Governor Marcy, of New York, appointed him, together with Ebenezer Emmons, T. A. Conrad, and Lardner Vanuxem, to make a geological survey of that State. Each of these principal geologists was assigned to one of four districts, into which the State was divided for the purpose. Mather had the first district, which comprised Washington, Saratoga, Schenectady, Schoharie, and Delaware Counties, and all that part of the State to the southeast of them. What this survey accomplished has been told by Dr. James Hall, in the Popular Science Monthly for April, 1883. The work of the survey lasted about seven years. During this time Prof. Mather made five periodical reports and a final report. This last forms a quarto volume of six hundred and fifty-three pages, with forty-six colored plates, being one of the set of volumes embodying the results of the survey and published by the State.

In 1837 a State Geological Survey of Ohio was projected and Prof. Mather was made chief geologist. This ill-fated project was killed after an existence of little more than two years by a spasm of economy which attacked the Ohio Legislature of 1839. Two annual reports had been presented, and were printed as State documents, and a report on the collections was made afterward, but there was no final report, and no provision was made for preserving papers, field-notes, and maps. A geological reconnaissance of Kentucky, authorized by the Legislature of that State, was made by Prof. Mather in 1838–'39, his report being issued as a State document. Both his appointment in Ohio and that in Kentucky had been accepted with the condition that they should not prevent the completion of his work in New York.

Colonel Charles Whittlesey has stated, in an article on the Personnel of the First Geological Survey of Ohio, that after the suspension of the Ohio survey, Mather bought a tract of several hundred acres, including the Pigeon Roost, north of the courthouse in Jackson County, and became a citizen of Ohio. He cleared a part of this land for a farm and built him a comfortable house on it. Afterward he and Prof. James Hall entered a large tract of Government land in the southern part of the same county, on which they erected an iron furnace.

When Mr. Mather settled in Jackson County, in 1841, it was impossible to obtain sperm oil there for domestic lighting. The only recourse of the family was to mold tallow candles, which was very unsatisfactory. In the following winter Mr. Mather

began experimenting on the preparation of oil from lard. He placed the lard in a canvas bag and suspended it in a warm room, thus obtaining by the slow process of dripping an oil that the family used in lamps. An account of these experiments was published, and is believed to have been the starting point of the production of lard oil, which has since become so extensive.

About the time the field work of the New York survey was finished, Prof. Mather became Professor of Natural Science in the Ohio University at Athens. He held this position from 1842 to 1845 and from 1847 to 1850, being vice-president and acting president in 1845. The period from 1845 to 1847 was occupied in examining mineral lands for mining companies, mainly about Lake Superior, but also in New Jersey, Virginia, and Massachusetts. During the first quarter of 1846 he was acting Professor of Chemistry and Geology in Marietta College, his other engagements making him unwilling to accept the professorship. In the winter of 1845 he began a series of experiments on the extraction of bromine from the bitter waters of the salt works near Athens, Ohio. At that time bromine, which can now be had for sixty cents a pound, was selling at sixteen dollars an ounce. The results of his investigations were published in the American Journal of Science. They showed that bromine could be obtained from these waters for much less than it was then costing, and resulted in the establishment of a plant at Pomeroy, Ohio, which produces the greater part of the world's present supply of this substance.

In similar public and private employments the rest of his life was passed. He was Agricultural Chemist for the State of Ohio, and Secretary of the State Board of Agriculture from 1850 to 1854. During part of this time he edited the Western Agriculturist, and during the last year was member for Ohio of the United States Board of Agriculture. He also continued to make examinations of mineral lands. His first wife having died, he married in 1851 Mrs. Mary (Harries) Curtis, who survived him. By this marriage he had one son. The person of Prof. Mather was large and robust, and he had a great capacity for physical and mental labor. He died February 26, 1859, in Columbus, Ohio, at the age of fifty-four. His death was sudden, and was ascribed to a complication of dropsy and paralysis.

In addition to his writings already mentioned, Prof. Mather contributed frequent papers to the American Journal of Science and other scientific periodicals, and he wrote many reports on the explorations made in the course of his professional work. He received the degree of LL. D. from Brown University in 1855, was a member of twenty-five scientific and literary organizations, a life-member of many religious associations, and for fifteen years a trustee of Granville College.

In his various expeditions he collected large numbers of minerals and geological specimens. His collection was much increased by exchanges with American and foreign geologists, and at his death contained about twenty-six thousand specimens. At present it is owned by his son Richard, of Ironton, Ohio.

Mr. Austin thus describes his character: "Equable in his disposition and gentle in his manners, considerate of others and just in his judgment of them, modest, but manly and self-reliant, thoroughly versed in the branches of science to which he devoted himself, he had neither dogmatism nor ostentation. As he observed in a letter to a personal friend, who differed from him in regard to a geological question, 'I am not wedded to any theory, but seek the truth—and when found adopt it.'" He was not inclined to court popularity, neither was his manner forbidding. Letters preserved by his family and friends give abundant evidence of his gentle disposition, firm principles, and high sense of honor.

The supremacy of his will-power over physical pain is illustrated in the following anecdote: "While making an examination of coal lands near Pomeroy, in Ohio, he was wounded in the second finger of his right hand. This wound induced a partial paralysis, and required an amputation of the finger. The cause of it was supposed to be a snake bite. As soon as he was convinced by the examination that amputation was inevitable, he directed the surgeon to procure a block, a chisel, and a mallet, and, placing his finger on the block, told him to sever the finger at one blow. This was attempted, but proved a sad failure. The chisel was too thin and highly tempered, and the edge crumbled. Nevertheless, he directed the surgeon to go on, and several blows were required before a complete severance could be made; although in this painful operation the bone was crushed instead of being cut, he bore it without flinching."

The substantial national reputation as a geologist won by William W. Mather was the result of the steady and conscientious application of a natural aptitude. "Not possessing the genius which dazzles," says his friend Austin, "he had the intellect which, continually improved by exercise, achieved valuable results by patient and conscientious industry. What duty demanded, that he performed regardless of consequences, either to himself or others. Not indifferent to fame, he never sought it by doubtful or devious courses. His object was not to enhance his reputation, but faithfully to do the work before him. Through the whole of his active and laborious life of thirty years in the cause of science, in all the various and important public positions which he occupied, no breath of censure assailed his integrity, which was a law of Nature with him, rather than a choice or a principle."

Editor's Table.

WOMEN AND POLITICS.

THE MONTHLY has lately given place to two articles on the subject of the demand which is now being made by some women on behalf of their sex to be allowed to participate in political life on a footing of perfect equality with men. One of our contributors has tried to show cause why the demand should not be granted, taking the ground that the change would be injurious to society as a whole and particularly injurious to the female sex. The other treats the arguments of the first with scorn, and, if we are not mistaken, betrays not a little of that "antagonism of the sexes" which nevertheless she declares to be "unnatural and vicious." The question is one which ought to be discussed with complete dispassionateness; and we think that on this score there was no fault to find with the earlier of the two contributions, that by Mr. George F. Talbot, in our May number.

Our second contributor, Miss Alice B. Tweedy, disclaims the idea that "woman suffrage is proposed as a panacea for social evils, or that it will usher in a millennial condition. Man," she adds, "would be disfranchised if such requirement was made of *his* vote." The retort is sharp, but is it logical? Miss Tweedy's main contention is that a suffrage restricted to men is fundamentally insufficient for the best social results; and yet she does not want that complete system of voting which she advocates judged by any higher standard than the present incomplete system. If, however, woman suffrage is not "proposed as a panacea for social evils," what is expected of it? Our contributor says that "stringent laws are needed to prevent various evils, and to make certain offenses punishable"; adding that "women are quick to recognize vicious tendencies that men with a greed for money-getting often overlook." "Men with a greed for money-getting" is a phrase which suggests reflections. What is the chief cause of the greed which men display for money? We do not think we are far wrong in saying that it is the social ambition of the women of their families. It is women far more than men who establish social ideals; and, so far as there is a scramble for money, it is their scramble, to say the least, quite as much as the men's.

This, however, is a side issue: the contention that concerns us is that laws are wanted to make certain offenses punishable that are not punishable now; and that women, being quicker than men to recognize vicious tendencies, would get such laws passed if they only had the suffrage. This is a case in which a few examples would be very serviceable. The proposed laws are either such as would recommend themselves to the approval and support of men, or they are such as would not so recommend themselves. If they are of the former kind, they can get passed now; if they are of the latter kind, it is presuming upon an easy compliance worthy of the immortal Captain Reece, R. N., to ask men to make a constitutional change for the express purpose of defeating their own views and principles. Our contributor acknowledges that in this country "most of the laws (that were unjust to women) have been repealed, that many others are a dead

letter, and that still others have been enacted that favor women." We must not, however, thank "man's own sense of equity and right" for these beneficial changes. Why? because they have all been subsequent to certain "writings and arguments" of "women agitators." So that man does not exhibit any "sense of equity and right" when he is influenced by the pleadings of "women agitators." Poor man! He is judged very severely these days. We should like to remark, however, that *post hoc propter hoc* is not a very sound form of argument. Grant that the "writings and arguments are a matter of record," it does not follow that these writings and arguments really determined the changes in legislation referred to. What we know is that the changes were made, and that they were made by men under no actual compulsion.

At the outset of her article Miss Tweedy states that, "if every man considered it a matter of conscience to give voice in his vote to the feminine element in his household, it would put another aspect upon the demand for woman suffrage." How is it now, we feel like inquiring, in this matter? We imagine that the great majority of men who put any conscience into their voting at all do consider, as far as it is possible to do so, the interests of the feminine element in their households. When a man votes, he votes for a certain individual who is seeking a certain office. The cases in which there can be any division of interest in the family as to which candidate should be supported must be exceptional. When, however, a man gives a vote for one side or the other, there is good reason to believe—corrupt motives apart—that he thinks, not solely of his own interest as a male individual, but of all the interests, domestic and social, which he represents. In that sense the average elector's vote is meant to be, and is, representative. Our contributor's idea is that "after a family conclave" the husband, father, or brother should "quietly pocket his own conflicting opinion and support the measures favored by the home majority." The plan is beautifully simple in appearance, but we fear would present difficulties in practice. The man who was earning a living for his family could scarcely be expected to pocket his opinion upon a question, such as protection or free trade, which he believed had an important bearing on his business prospects; but at the same time we are sure that most men would be very glad to have any assistance which the female members of their households could give them in arriving at right conclusions on questions of the day.

If women are to be called upon to vote, it should be for very broad and sufficient reasons. The mere fact that some are demanding it is not a sufficient reason, inasmuch as others, and probably the great majority, not only do not join in the demand but are prepared to oppose it. Let us endeavor to indicate briefly how the matter presents itself to our mind.

In the exercise of the suffrage the individual asserts himself, claiming his share of political power. The vote is given to him for the protection of his political rights against the encroachments of other men. On voting day society is momentarily resolved into its constituent units. As long as men alone do the voting, they are supposed to represent the non-voting sex. Every man has or has had a mother, most have one or more sisters, and a very large proportion have wives. Every man's vote, therefore, we do not hesitate to say, ought to express his consciousness of

and respect for the family tie. To summon women to the polls would signify an antagonism between their interests and those of men. It would signify that a man and the women of his household are separate social units in the same sense in which two men are, and that they require protection against one another—that each must be armed with the ballot lest the others encroach. This assumption, in our opinion, is not warranted. Making all deductions for unfortunate instances, the family is in general a unit, and the wife, daughter, or sister has no desire to antagonize the vote of the husband, father, or brother. How about those women, it will be asked, who have no husband, father, or brother to represent them in a satisfactory manner? Our answer is that their case does not appear to us to be one of hardship unless it can be shown that, *considering them as a class apart from those who have male relatives*, they are suffering through lack of political influence. Simply as women they receive whatever benefit accrues to the sex in general through such improvements in the law as are daily taking place, and through the sympathy with woman which characterizes the normal man. To a considerable extent also the same means of influence are open to them as are open to other women. They are not cut off from society: they can speak and write; and how potent "women agitators" can be in procuring changes of the law Miss Tweedy has told us. What is mainly needed, in our opinion, is the deepening of the sense of trusteeship in men, and that fortunately is a process which is realizing itself more and more before our eyes. Far better so than that all trusteeship should be snatched from man with the snappish declaration that henceforth his wife, daughter, and sister will take care of their own interests. A singular time indeed for such a change to be made, when things have so shaped themselves that so earnest a female suffragist as our contributor is hard put to it to say what the disadvantages are under which women labor through man's control of the suffrage, or what laws they want passed which if duly explained and urged they could not now get passed!

There are other views of the question which we have only space to glance at. We can not lose sight of the fact that all law means compulsion—physical compulsion in the last resort; and this to our mind points to the conclusion that the responsibility for making laws should rest with those who could if necessary fight for their enforcement. It has before been pointed out that the situation which would be created if a large majority of women, in combination with a minority of men, passed laws repugnant to a large and effective majority of men, would be a very critical one for social order. Yet if nothing of this kind is going to happen, it is difficult to see where the special influence of woman's vote will come in.

Another point deserving of consideration is that the male sex, when all is said and done, is the progressive sex. Mr. Havelock Ellis's interesting and certainly far from prejudiced book on Man and Woman makes this clear. Broadly speaking, woman shows the statical, man the dynamical, aspect of humanity, and, as the work of legislation is in its nature continuous and progressive, it seems natural that it should be intrusted to that sex which best represents the onward movement of the race. Here, however, we must adjourn the discussion, which is one difficult to confine within narrow limits. Much probably remains to

be said on both sides, and we have no doubt the soundest arguments will prevail in the end.

THE DEVIL IN THE PUBLIC SCHOOLS.

A FEW weeks ago a most extraordinary story appeared in the daily papers of this city—a story of a panic that had occurred in one of our public schools in consequence of a statement made by a little girl that she had seen the devil coming into the building. It was at the hour of the noon recess, and the boys and girls were in their respective playrooms. No sooner had the words been uttered than all the girls in the room were seized with abject terror and began to scream in a frenzied manner, begging and praying to be saved from the fiend. The boys, whose room adjoined that of the girls, heard the shrieks and became almost equally terror-stricken. When the teachers appeared on the scene they could not for some time learn what the cause of the excitement was, so hysterical had the whole mass of the children become. Shortly a crowd gathered round the building, largely composed of women who had children in the school, and who, when they heard that the devil had appeared on the premises, became perfectly frantic themselves. The police having been sent for took possession of the building, and with considerable difficulty peace was finally restored.

It would appear from this that the devil superstition is not quite so extinct in the community as most of us perhaps have been in the habit of believing. It seems the children had been frightening one another for some time previously with stories of the devil, ghosts, etc., so that there had been a certain preparation for the panic that finally broke out. This is a matter, we think, in which teachers might very properly interest themselves a little. It does no small child good to believe in a devil capable of donning the conventional horns and tail and starting out on errands of destruction; and it is not probable that any important theological doctrine could be upset if children were told that such a devil was really a negligible quantity. There ought to be some way of talking even to very young children which would tend to take their thoughts off ghostly mysteries of all kinds, and concentrate them on what is beautiful and interesting and healthful in the world around them. The true corrective to devil worship —and all fear of the devil is a kind of worship—is the study of Nature and of the powers inherent in Nature. It should not be difficult to make children feel that there is really no scope left for the devil in the world as we know it to-day. Of course, if their parents or Sunday-school teachers, on the other hand, tell them that the devil goes about like a roaring lion seeking whom he may devour, the more wholesome teaching which we are advocating may be so far antagonized. No effort should, however, be spared in the public schools to put all the thoughts of the children on a natural and rational basis, and thus as far as possible to secure for them immunity against hurtful and degrading superstitions. This incident should be taken to heart by teachers generally, as showing the importance of knowing what thoughts are really engaging the minds of their pupils. The devil has had his day—he had a good thousand years of human history pretty much to himself—and there is really no impropriety in trying to keep him out of the schools of modern New York.

Scientific Literature.

SPECIAL BOOKS.

In his recently published History of the Warfare of Science,* Dr. Andrew D. White has given the world a work of great practical value—a work to which we can confidently refer any one who desires to know not only what is thought to-day in the principal departments of scientific inquiry, but by what stages the crude and illogical fancies of an earlier period gave way to conclusions founded on observation and induction. The title of Dr. White's book, we have no doubt, will give offense in certain quarters, but it would be difficult to say how the actual content of the book could be otherwise expressed. It is a narrative of conflict in which we invariably find that conclusions derived from the study of facts have had to make their way against opinions resting on the supposed authoritative utterances of a sacred book. In whatever direction we turn we find that theology has been beforehand with science in telling men what to believe, even in matters that turn on the evidence of the senses, and that science has to climb over mountains of obstruction and wage many a desperate battle before it can secure the right to deliver its message to mankind. How can this conflict be described otherwise than as Dr. White has described it? It is not a conflict merely between true science and false science, between sound views and unsound views, but a conflict between the observation of Nature and of facts generally and an utterly unreasoning adherence to *things said*. It is a struggle of *data* against *dicta*, science taking its stand on the former and theology on the latter. It is true that theology has, in these later days, reconsidered its position, and consented to hand over to the jurisdiction of science vast regions of thought which it once assumed to rule with absolute authority; but none the less was it theology which fought science step by step in the past, and that not by argument in any true sense, but by the weapons of physical force, and often in a spirit of intolerable arrogance and cruelty.

Although the rôle in which theology is necessarily made to appear in the volumes before us is a decidedly unamiable one, it would be unjust to Dr. White not to recognize the kindly and charitable spirit in which his work is written. He deplores the crimes against intellectual liberty that were perpetrated by ecclesiastical powers, but he rarely excites our enmity against the individuals concerned. He shows that they acted according to their lights, that their judgments were overpowered by the authority which it was common in their day to ascribe to sacred texts, and that, in resisting the most convincing demonstrations of scientific truth, they honestly believed they were following a surer and higher guidance. To them science, or the observation of Nature, represented at best the unaided operations of the human intellect, whereas Holy Writ contained the direct and authentic teaching of the Divine Spirit. How, then, could they hesitate between the two? How could they fail to consider as guilty of dangerous impiety those who ventured to set up the former against the latter? As we read Dr.

* History of the Warfare of Science with Theology in Christendom. By Andrew D. White, LL. D., L. H. D. 2 vols., 8vo, New York: D. Appleton & Co. Price, $5.

White's interesting pages we are made to feel the strength of the theological case as it presented itself to the minds of churchmen and devout believers. The Scriptures were divinely inspired: that was the first postulate. The Scriptures stated so and so in express terms, and had been understood and accepted in their plain sense by the greatest doctors and saints of the past, men whose dicta had an authority only less than that of Scripture itself. That was the second half of the argument. Was the authority of Scripture to be impugned and discredited because a few men of no authority, as authority was reckoned in those days, professed to have made this or that discovery in one region or another of physical observation? To let Scripture go was to let everything go, to destroy the whole basis of church authority, the whole foundation of social and moral order; and how to twist Scripture into seeming agreement with the alleged discoveries they had not yet learned. How the intellectual life of Europe was crushed for centuries under the weight of scriptural authority, how the scientific impulse, though a thousand times slain, a thousand times revived, how little by little true views of Nature forced themselves upon a priest-led world, and how in the end Science too gathered to herself authority and made for herself the dominant position which she enjoys to-day—all this, most graphically and sympathetically related, is the burden of the two handsome volumes before us.

There is one point upon which Dr. White has especially labored to be fair. He has not laid, as some writers have been more than half disposed to do, the whole reproach of obstructing and persecuting science upon the Roman Catholic Church. He makes it plain that science, so to speak, *had* to be persecuted by any body of men who were in the toils of such a theology as that which the early Christian Church formed for itself and bequeathed to later ages; and he shows how the several Protestant churches just in so far as, and so long as, they held to that theology were no less hostile to rising science than the old Church had been. It would indeed almost seem as if, within the last generation, the Catholic Church had more frankly made its peace with the methods and conclusions of science than the several Protestant churches have done; certainly the most recent examples of opposition to science which are quoted in these volumes are drawn from the proceedings and utterances of Protestant authorities, not of Catholic ones.

It is only right, however, that we should give a more adequate indication than we have yet done of the scope of the present work. The first chapter, which is entitled From Creation to Evolution, deals with the history of opinion on the subject of the origin and development of the physical universe. The crude ideas of ancient times are well represented, the author tells us, by a design which appears in one of the stained-glass windows of the cathedral at Ulm in Würtemberg, where the Almighty appears as busily engaged in the creation of animals, and has just turned off his hands an elephant fully accoutered with armor, harness, and housings, ready for war. In like manner we may still see in the Egyptian temples at Philæ and Denderah representations of the Nile gods modeling lumps of clay into men. "So literal," says our author, "was the whole conception of the work of creation that in these days it can scarcely be imagined. The Almighty was represented in theological literature, in the pictured Bibles, and in works of art generally, as a sort of enlarged and venerable Nuremberg toymaker." The slightest statement of Scripture in

regard to the constitution of the natural world was a sufficient foundation for the most highly elaborated beliefs; and the "yarns," if we may so designate them, which were told about the dragon, the unicorn, the leviathan, and one or two other unique animals mentioned in the Bible showed plainly that the imagination of our ancestors was in a state of high activity, whatever may have been the case with their logical faculties. The gap between such a condition of mind and that which prevails among the educated classes of our own day is vast; but Dr. White enables us to see by what successive accretions of knowledge a pathway was made from one to the other. To-day the idea of development is supreme, and that of creation, which was the only one our ancestors could entertain, has become almost an intellectual impossibility. In other words, we do not know how to go about thinking of creation, while familiarity with the fact of development, as it takes place in many ways before our eyes, has caused us to regard it as the typical and characteristic process by which all the constructive work of Nature is wrought.

The second chapter deals with the progress of thought on the subject of geography, including the form and size of the earth and the once much-vexed question of the antipodes. The third chapter takes up the subject of astronomy and gives a deeply interesting account of the struggle for the establishment of the Copernican system. Dr. White makes it clear that the opposition to the true view of the universe was almost if not quite as keen on the part of Protestant as of Catholic churchmen. Luther is quoted as saying: "People gave ear to an upstart astrologer who strove to show that the earth revolves, not the heavens or the firmament, the sun and the moon. . . . This fool wishes to reverse the entire science of astronomy; but sacred Scripture tells us that Joshua commanded the sun to stand still, and not the earth." Melanchthon argued in the same strain, and Calvin asked who would dare "to place the authority of Copernicus above that of the Holy Spirit?" In many universities, we are told, as late as the end of the seventeenth century, "professors were forced to take an oath not to hold the Pythagorean—that is, the Copernican—idea as to the movement of the heavenly bodies." University authorities used to make it their boast in those days that such pernicious doctrines had no place in their system of teaching, just as university authorities in our own day—it is our author who draws the parallel—sometimes boast that they discourage the reading of Mill, Spencer, and Darwin.

Further chapters are entitled From Genesis to Geology, Antiquity of Man, Fall of Man and Anthropology, Magic to Chemistry, Miracles to Medicine, Babel to Philology, etc., and all are replete with important information interestingly presented. Considered alone as a popular presentation of modern views upon the great scientific questions of the day, the work deserves to be widely read; but its value is greatly increased by the light which it sheds upon the development of opinion and the clearness with which it establishes the contrast between the fruitful methods of science and the unfruitful ones of theology in the domain of nature. Finally, it is, as we have already hinted, written in a large, tolerant, and sympathetic spirit, suggesting a mind raised altogether above petty prejudices and narrow enmities. It is a pleasure to us to think that the greater part of the matter contained in the work was first given to the public in the pages of the Popular Science Monthly.

The readers of this magazine have already had a chance to enjoy more than half of Prof. *James Sully's* volume of *Studies of Childhood** in the series of articles which the author has contributed to our pages within the past two years. The additional matter consists of an introduction, part of the chapter on the Young Draughtsman, about ninety pages of Extracts from a Father's Diary, and a chapter on George Sand's Childhood based on that talented woman's Story of my Life. Prof. Sully by no means regards these studies as a complete treatise on child-psychology. They "merely deal," he says, "with certain aspects of children's minds which happen to have come under my notice, and to have had a special interest for me."

The first topic discussed is imagination—the happy faculty that gives playmates to the child isolated from others by distance, dangers of the outdoor world, illness, or other circumstances, and that turns familiar surroundings into scenery and accessories appropriate for imitating any desired activity of adults. From an examination of the examples that he has collected Prof. Sully concludes that imaginativeness varies greatly in different children, and that "there must be a much wider and finer investigation of children's action and talk before we can feel quite sure that we have got at their mental whereabouts." He maintains further that imagination and practicalness are not mutually exclusive in the minds of children, and gives evidence to show that first one tendency, then the other, may be dominant for days, and also that the one may succeed the other with astonishing rapidity in the same child. Probably the most entertaining chapter is that on The Little Linguist, in which the various phases of the child's struggle with the mother tongue are described and copiously exemplified. It is peculiarly difficult for the adult to put himself in the child's place with respect to fear of darkness, unusual objects, etc., so that the data that Prof. Sully is able to furnish on this subject are especially welcome. The part of the volume that will probably most interest the non-scientific parent or teacher is the two chapters bearing on the question why children seem to be imbued with so much concentrated naughtiness. Prof. Sully shows that it is not necessary to assume innate viciousness to account for acts of the child that inflict pain on other persons and on animals, for persistent lying, or for disobedience. Further, he shows that the child has a natural tendency to orderly procedure which needs only to be encouraged by consistency on the part of the parent to make the departures from right conduct very few. Prof. Sully draws conclusions freely from his facts, but probably no one would affirm more readily than he that these conclusions should be held subject to modification in the light of further evidence. It might have been better if this caution had been explicitly stated, or if some of the conclusions had been less confidently expressed.

* Studies of Childhood. By James Sully. Pp. 527, 8vo. New York: D. Appleton & Co. Price, $2.50.

GENERAL NOTICES.

It is doubtful if any more generally interesting subject will be found for the Library of Useful Stories than the one treated in the second volume that Mr. Chambers* has contributed. It is evident also that this author has the faculty of making a truly

* The Story of the Solar System. By George F. Chambers. Pp. 188, 16mo. London: George Newnes, Ltd. 1s. New York: D. Appleton & Co. 40 cents.

popular scientific book. His text is everywhere readable, and his pages never bristle with repellent figures. Mr. Chambers gives a chapter to each of the planets, and one each to the sun, moon, minor planets, and those impressive wanderers, the comets. His mode of treatment gives the reader a personal acquaintance, as it were, with each member of the system by making prominent those characteristics of each which are of chief interest. His chapter on the sun gives especial attention to sun-spots; that on the earth to refraction, twilight, and the twinkling of stars which are phenomena of its atmosphere; that on Mars to its canals that on Jupiter to its satellites; that on Saturn to its rings; that on Uranus, as also that on Neptune, to the story of its discovery. On account of the lively popular interest in comets the chapter on these bodies is made second only to that on the sun in fullness. There are twenty-eight illustrations.

We are disappointed in this book—and glad to be.* From its title we inferred that it was a tissue of dogmatic assertion and ecstatic speculation; but examination shows it to contain a clearly arranged and vigorously presented chain of evidence concerning the physical and mental development of man. This is followed by a firm statement of belief in the teachings of the Bible. It consists of a series of lectures delivered on the foundation given by S. F. B. Morse to Union Theological Seminary with one additional chapter. The students who heard the lectures received a valuable addition to their equipment for their life work, and if the persons who are attracted by its title will read the book they will derive probably unexpected benefit from it. After an examination of the manner in which the problem of man's past has been largely solved, Prof. Tyler starts with the amœba, and in three chapters traces the course of animal evolution up through the invertebrates and lower vertebrates to man. In the next chapter mental development is similarly traced. The general nature of the process by which man has been produced is then discussed. "The animal is at first guided," says Prof. Tyler, "by natural selection through the survival of the most suitable reflex actions, then by inherited tendencies, finally by his own conscious intelligence and will. The first motives are the appetites, but these are succeeded by ever higher motives as the perceptions become clearer and more subtile relations in environment are taken into account." Conformity to environment, as our author describes the process, enables an animal to survive his less fortunate fellows; but if the animal is to progress it must keep such conformity secondary to obedience of the laws of its own structure and being. Man as he is to-day is the outcome of such a line of conduct, and his future upward progress depends on his measuring himself by ever higher and higher standards. It may be questioned whether this adaptation of men and animals to their surroundings ever becomes so largely voluntary as Prof. Tyler seems to represent. In the course of this discussion the author passes out of the field of science into that of religion, and in a chapter specifically devoted to the teachings of the Bible he insists on the reality of revelation and the efficacy of prayer, and gives some practical advice to young preachers. A chapter not forming one of the lectures concludes the volume. This deals with some of the present aspects of evolution, including Nägeli's theory of inherent initial tendency and giving especial attention to Weismann's views.

* The Whence and the Whither of Man. By John M. Tyler. Pp. 312, 12mo. New York: Charles Scribner's Sons. Price, $1.75.

The widespread use of electricity and the numerous casualties resulting from ignorant or careless wiring make Mr. Robb's book* on electrical wiring a very timely one. It has evidently been intended mainly for the use of architects and insurance companies, but the text is so simply and clearly written that the ordinary householder will have no trouble in following it. Insulation, which is one of the most important portions of electric installation, is first considered; then the proportioning of wires to current, and the various systems of distribution and methods of wiring. The

* Electric Wiring, for the Use of Architects, Underwriters, and the Owners of Buildings. By Russell Robb. Pp. 183-800. New York: Macmillan & Co. $2.50.

remainder of the book is taken up by a consideration of the national code of rules for electric wiring. This code, which has gradually been molded into its present shape by the underwriters, is now generally accepted by the best electrical companies. It is the result of a careful study of past accidents due to faulty wiring, and much experimental work with the various insulators and electric appliances. As the rules are necessarily short and contain many technical terms, Mr. Robb has, where necessary, defined the terms, and after each rule has stated the reasons for it. The book is well conceived, and should find a large field of usefulness especially among architects, who, as the author says, are not nearly so well up in electrical matters as they should be.

The essay for which a prize of five hundred dollars from the Henry M. Phillips fund was awarded by the American Philosophical Society in 1895 has been printed in the Proceedings of the Society. Its subject is *The Theory of the State*, and the writer is *George H. Smith*, of Los Angeles. Mr. Smith makes four chief divisions of his discussion, namely, (1) the nature of the state, (2) its functions, (3) its rights or rightful powers, and (4) the principles that should govern its political organization. In an introductory chapter he criticises the doctrine of absolute sovereignty as generally received in modern times, which he regards as standing in the way of an intelligent investigation of his subject. After discussing other definitions of the state he defines it as "an autonomous society of men," and proceeds to treat of the functions of such an organization. The rights or just powers of the state he treats as a subdivision of jurisprudence, using this word to mean the whole science of right. In his final chapter he deals with the principles of political organization, describing the several kinds of government, and discussing the principles that should govern the distribution of the sovereign powers.

The *Elementary Treatise on Electricity and Magnetism*, by *G. C. Foster* and *E. Atkinson* (Longmans, $2.25), affords a substantial college course in its subject. The work is a translation, considerably modified with the consent of the author, of Joubert's *Traité Élémentaire d'Électricité*. A notable departure from the original consists in the introduction of that view of the nature of electrical phenomena which was originated by Faraday and developed by Maxwell. This has involved keeping in view throughout the volume the dual character of electrification and emphasizing the essential part played in familiar electrical phenomena by the dielectric medium in which they occur. On the same account the idea of lines and tubes of force has been early introduced, and charge, capacity, and energy are spoken of as belonging to the electric field as a whole, rather than to the conductors which bound it. The work is almost exclusively devoted to the laws and principles of the science, giving but little attention to applications and none to history, and nearly all of its three hundred and eighty-one illustrations are cuts of laboratory apparatus or diagrams. The authors have made more use of mathematical reasoning than M. Joubert did, so that processes of calculation by the aid of formulas appear in every chapter.

It would seem possible to select a laboratory manual of chemistry suitable for almost any class from among those now published. One recently prepared by Prof. *Edward H. Keiser*, of Bryn Mawr (American Book Company, 50 cents), furnishes a list of two hundred and sixty-eight elementary experiments illustrating the properties of the common elements and the chief laws of chemical action. Certain of these experiments, designated Laboratory Demonstrations, are intended to be performed only by one or two of the more skillful students in the presence of the whole class. Questions are interspersed with the directions, some of which can be answered from the observations made on the experiments, and the rest from the text-book or lectures that will accompany the manual.

Mr. *Arthur H. Hiorns*, who is the author of several books on related subjects, has now written *Principles of Metallurgy*, a somewhat more advanced work than his Elementary Metallurgy, and containing new methods that have been introduced in recent years (Macmillan, $1.60). The arrangement of the matter is thus outlined in the preface: "The physical properties of the metals are considered first; then the chemical principles involved in the various processes are

explained; the information concerning the metallic alloys is placed together; this is succeeded by a description of fluxes, slags, and refractory materials; the nature and mode of preparation of different kinds of fuel are next referred to; then follows a more detailed description of the metallurgy of iron and steel, silver, gold, platinum, lead, copper, zinc, tin, nickel, cobalt, aluminium, antimony, arsenic, and bismuth." The properties of each metal are given and something is told of its uses. There are one hundred and forty-four illustrations, including cuts of furnaces and other apparatus, diagrams showing the course of operations, etc.

In a series of chapters which might well have been sermons, under the title *Old Faiths and New Facts*, an effort is made by *William W. Kinsley* to show that the beliefs in miracles, in the efficacy of prayer, in the divinity of Christ, and in a future life need not be disturbed by the discoveries of modern science (Appletons, $1.50). Two chapters of the book have appeared in the Bibliotheca Sacra, and those on prayer, at the instance of Bishop J. H. Vincent, were used as part of the prescribed Chautauqua reading for 1894. The volume will doubtless help many who have been dazzled by the new light of science to retain their religious beliefs.

An examination of various abuses in American public affairs comes to us in a volume by *Frederick W. Schultz*, entitled *Politics and Patriotism* (Arena Publishing Company). The author traces the growth of the American political ideal through colonial times, the Revolutionary period, and, after some discussion of the later amendments to the Constitution of the United States, carries his subject through the civil war and reconstruction periods. He next criticises the protection and greenback doctrines, and shows how selfishness is productive of many evils in the industrial relations. Inequalities of taxation are discussed at considerable length, and a series of striking examples possible under the laws of Maryland is given. In the concluding portion of the volume a brief history of exposures of corruption in New York, Baltimore, and other large cities is presented, and a scheme is offered for securing pure primary elections, which the author holds is the first step toward municipal reform. Mr. Schultz, who introduces himself as a man busy with mercantile affairs, writes with much feeling but temperately, and expresses himself clearly and concisely. His book is one to stimulate thought in the average citizen.

Evidently the true reason for the publication of the collection of *Fables and Essays* recently issued by *John Bryan* is that given in the preface, namely, "the same reason a hen lays eggs"—for relief to the author. Liberty and justice are the two avowed motives of the book. In the fables, brief essays, and bits of verse which it contains, satire and sentiment are mingled. The ideas that oftenest find expression in its pages are hatred of industrial and social oppression, and of priestcraft, honor and tenderness for the natural woman, impatience with the unnatural, sympathy with the victims of selfish greed, contempt for arrogance and pretense, and intolerance of artificiality in manners, education, and conduct. The personality of the author is everywhere apparent in the volume, and if the reader does not like that personality, Mr. Bryan makes it very evident that he need not read the book (The Arts and Lettres Company, New York).

A neat little handbook on *Physical Measurements*, by *L. W. Austin* and *C. B. Thwing*, has just come to hand. It is intended as a guide for the elementary student in the physical laboratory, and "simply presupposes such a knowledge of the principles of physics as can be gained from a course of general lectures supplemented by a good text-book." Each physical law, with the special pieces of apparatus for applying it to physical measurements, is taken up, and after a thorough description examples for testing the student's grasp of the principle are given. The last fifty pages of the book consist of the tables necessary for making computations and verifying the results (Allyn & Bacon, $1.50).

The portion of the college curriculum in which the most valuable and practical knowledge is obtained is the laboratory at any rate, in the physical sciences, and in some of the more abstract and difficult subjects, such as psychology, there is an increasing use of laboratory methods. In *Mechanics*, the last

of the Cambridge Natural Science Manuals to reach us, Prof. *R. T. Glazebrook* has embodied the results of his experience as a teacher both in the laboratory and its adjunct, the lecture room. The first portion of the book deals with dynamics, the second with statics, and the third and last with hydrostatics—two hundred and eight pages in all. Each physical law is illustrated by means of simple apparatus and experiments, and examples are scattered through the text for testing the student's grasp of each principle. The book is well printed and bound; illustrations are used where necessary; and although the work is by no means a complete treatise, it seems thoroughly good as far as it goes, and well suited to the needs of elementary students (Macmillan, $2.25).

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Fragments of Science.

Nutritive Value of Meats.—In a recent article on the value of meats as food, in the Dietetic and Hygienic Gazette, Prof. R. H. Chittenden corrects several very widespread misconceptions regarding meat values. He says: "The cheapest food is that which supplies the most nutriment for the least money. The well-known maxim that 'the best is the cheapest' is not true of foods, for the term best in this connection is ordinarily applied to that which has the finest appearance, the finest flavor, the most tender structure, etc. Thus, there is no more nutriment in a pound of proteid from tenderloin steak than in the same weight of proteid from the neck or shoulder, and yet note the great difference in cost. The tenderloin will not supply the body's needs one particle better than the coarse-grained meat from some other quarter. A great deal of money is spent by people who can ill afford it, because of this notion that the more expensive cuts are the more nutritious; much of it is perhaps attributable to lack of knowledge of the art of cookery. The housewife, not knowing how to properly prepare the cheaper grades of meat so as to make them palatable and attractive, concludes that they are not as nutritious as the more tender and juicy cuts that can be bought only at a higher price, and which require little judgment or skill to prepare for the table. Here is a field for missionary labor that will well repay the cultivation. Knowledge of this kind may be advantageously acquired by those whose means render it perhaps less vital; for a waste of food material is a crime against both pocket and morals." In speaking of the value of meat as a food in relation to the other food stuffs, Prof. Chittenden says: "Various extractives, active principles, etc., all endowed with more or less physiological properties, are likewise ingested as a part of the meat, and add their effects, perhaps to aid in keeping up the tone and vitality of the organism. Meats have certain stimulating properties, which distinguish them from the grosser vegetable foods. In this respect they might perhaps almost be classed with such articles as tea, coffee, etc., in their power of ministering to the wants of the brain and nerves. As Sir William Roberts well says: 'The struggle for existence, or rather for a higher and better existence, among civilized men is almost exclusively a brain struggle, and these brain foods must be regarded as a very important part of the

equipment for that struggle. If we compare as best we may with our limited information the general characteristics of the high-fed and low-fed classes and races, there is, I think, to be perceived a broad distinction between them. In regard to bodily strength and longevity the difference is inconsiderable, but in regard to mental qualities the distinction is marked. The high-fed classes and races display, on the whole, a richer vitality, more momentum and individuality of character, and a greater brain power than their low-fed brethren; and they constitute the soil or breeding ground out of which eminent men chiefly arise.' It is well understood that differences in mental capacity may be explained, in part at least, by differences in the type of nutrition of the brain cells, and nutrition is unquestionably modified and influenced by the quality of the food consumed. To again quote Sir William Roberts: 'Trainers will tell you that the hunter and the draught horse require to be fed differently. In the hunter is wanted rapid liberation of energy within a comparatively short space of time; in the draught horse is wanted a more gradual liberation of energy and for a longer period. The hunter is fed on a concentrated and stimulating food, the heaviest and most expensive oats, which, if I may so express it, is the beef of the vegetable feeders, while the draught horse is fed on a lower and less stimulating diet—on Indian corn and chopped hay, food which tends to increase bulk and weight.' So with mankind, the nature and quality of the nutrient—aside from its containing the due proportion of the several requisite elements—exert a specific influence upon the character of mind and body; and meats may be fairly placed in the front rank of foods as giving important aid toward that higher physical and mental development which belongs to the civilization of the nineteenth century."

Uranium.—Until the introduction of the electric furnace by M. H. Moissan, the oxides of many of the metals had been looked upon as irreducible by carbon. M. Moissan, three years ago, isolated the metal uranium in this way. The metal, when pure, is perfectly white, and is not magnetic. It has the remarkable property of emitting invisible phosphorescent rays capable of producing photographic effects through a medium opaque to ordinary light vibrations. The effects are precisely similar to those previously obtained from uranium salts, except that they are nearly four times as intense. The chemical behavior of uranium depends to a certain extent upon its state of division. The metal obtained by electrolysis, which is finely divided, takes fire in fluorine, is attacked by chlorine at 180°, by bromine at 210°, and by iodine at 260°, the reaction in all cases being complete. The powdered metal is completely burned in pure oxygen at 170°, and decomposes water slowly at the ordinary temperature, but more quickly at 100°. Uranium is one of the rapidly increasing group of metals which combine directly with nitrogen at high temperatures, and hence in its preparation it is necessary to work in such a manner as to completely exclude the air.

Working in Compressed Air.—E. W. Moir, in a paper read before a recent meeting of the Society of Arts, gave some interesting data regarding the effects upon the human system of working in compressed air and the various practical means of lessening the danger and overcoming any sudden collapses. Mr. Moir had charge of the work on the Hudson River Tunnel for a time, and has had some connection with most of the underground tunneling ventures of the past two decades. He says: "When I first came to New York the men had been dying at the rate of one man per month out of forty-five or fifty men employed, a death-rate of about twenty-five per cent per annum. With a view to improving this state of things, an air compartment like a boiler was made, in which the men could be treated homœopathically, or reimmersed in compressed air. It was erected near the top of the shaft, and when a man was overcome or paralyzed, as I have seen them often, completely unconscious and unable to use their limbs, they were carried into the compartment, and the air pressure raised to about one half or two thirds of that in which they had been working, with immediate improvement. The pressure was then lowered at the very slow rate of one pound per minute, or even less, the time allowed for equalization being from twenty-five to thirty minutes, and, even in severe cases, the men went away quite cured. No man ever suffers

by going into compressed air, unless his Eustachian tubes are blocked, in which case intense pain is produced, owing to the great difference in pressure between the two sides of the ear drum. The above-described lock should be used immediately on prostrations occurring, as it seems to be of little value after some time has elapsed. A very slight increase of carbonic oxide (if it much exceeds one part in a thousand) in the compressed air chamber leads to increased sickness. The impurity never affects a man while below, but only after he comes out, and we had mules working under pressure in New York for over twelve months at a stretch, which sold at good figures after coming out. Every man should be medically examined, and hot coffee should be given to each man before he comes out of compressed air. A warm room to dress in and extra clothing for passage through the lock should be supplied. At the Blackwall Tunnel, with the experience gained and attention to the above points, we have not had a single death, notwithstanding the fact that we had men working under a pressure of thirty-seven pounds per square inch for some time. Generally sparely built men, not too full-blooded, are those who stand air pressure best. A man with weak lungs may work and improve, but one with a weak heart or any apoplectic tendency should not go in at all. Drink of all classes is bad, but such drinks as tend to thicken the blood are worse than spirits."

The Electro-metallurgy of Aluminium.— Dr. Joseph W. Richards recently delivered before the Franklin Institute a very interesting and instructive lecture on the electro-metallurgy of aluminium. Several years ago the daily press gave considerable space to descriptions of the new aluminium industry and discussions of the modifications which its cheap production would bring about in the arts. While it subsequently proved unsuited to many purposes for which it was at first thought well fitted, it has become quite an important staple, and its applications are gradually increasing. Dr. Richards thus describes the process of manufacture: Pure alumina made from ore by a chemical process is stirred into a fused solvent bath composed of the double fluorides of aluminium and sodium. This bath may be simply cryolite, but preferably cryolite to which has been added a further proportion of aluminium fluoride and a little calcium fluoride (fluorspar). The alumina is dissolved by the bath to the extent of one fifth of its weight. The electric current is then sent through this mixture, using for anodes carbon rods dipping into the bath from above. The cathode is formed by the carbon lining of the vessel, on the bottom of which the melted aluminium collects. When the dissolved aluminium has nearly all been removed, the resistance of the bath rises, and fluorine fumes, from the decomposition of the solvent, begin to appear; fresh alumina is then stirred in and the operation thus proceeds continuously. The cavity containing the fused salt has a sump in which the molten aluminium collects and from which it is removed by ladles. The action of the current, when not of too high a voltage, is to decompose only the alumina as long as it is present in the bath in sufficient amount. The oxygen simply combines with the carbon anodes and passes away as carbonic oxide. The above process was discovered independently in 1886 by Heroult in Europe and Hall in America. In 1888 Hall put aluminium thus made on the market. The plants now engaged in making aluminium on this principle are as follows: The Pittsburg Reduction Company, at New Kensington, Pa., and at Niagara Falls, having a daily capacity of 4,400 pounds; the works at the Rhine Falls in Switzerland, capacity 5,000 pounds; and works at La Praz and Saint-Michel in France, with a combined capacity of 5,500 pounds. Besides these, there are in contemplation or course of erection five other plants, which will raise the total possible daily output to 42,900 pounds.

A Convention of Dragon Flies.—Some curious movements of dragon flies were observed one September afternoon by Prof. Charles Barrois, of Lille, along a road near Morbihan, France. The insects were seen, thousands in number, seated along the telegraph wire, all in the same position, their bodies in the axis of the wire, their heads turned west toward the setting sun, and their abdomens making an angle of twenty-five degrees with the wire. New insects were coming from every side, plunging first

toward one of those which were fixed, and hovering a few inches away from them, but only for a few minutes. The fixed insect turned its abdomen a few degrees, when the second immediately settled on the wire in the same attitude as the others, into an absolutely motionless position. The distance between the insects varied from about four to twelve inches, the average being about eight inches, while no two were closer together than four inches. They never came with full force upon the wire, but were seen pouncing from all points upon the settled individuals, when the proceedings described above followed; the insect always fixing itself so as to have a little clear space toward the west. Once settled, the dragon flies remained motionless, as if hypnotized by the reflection of the sun from the wire in front of them. Occasionally one would leave the wire, but always to settle itself at once a few yards farther on; none went away upon a long flight. M. Barrois found the wires thus occupied by dragon flies—he estimates that there were sixty thousand of them—for eight or nine miles, to where the line turned abruptly toward the south. The position of the insects, with their heads turned west, indicates that they were attracted by the sunlight; and the space which they all kept to the west of them was that required to afford a clear opening in which the reflection could take place.

Characteristics of Alpine Plants.—As described in Garden and Forest by M. H. Correvon, of the Alpine Garden, Geneva, the vegetation which thrives on great altitudes, like those of the Alps, Andes, Himalayas, and the mountains of Oceania, shows a distinct individual character readily noticeable. The plants are usually stunted, short-stemmed, or stemless, with flowers relatively exaggerated in size. The large flowers are almost sessile, with hardly apparent and only slightly developed foliage, which at a very high level is often clothed with a fine, close down, so as better to withstand the effects of cold nights. In many cases the foliage is glabrous, when it is also usually coriaceous (with tissues especially adapted to resist the frosts of Alpine climates); and the leaf, of a firm, close, thick texture, is provided with a solid epidermis and covered with a waxy coating, which enables it to withstand the effects of the sun as well as those of an excess of humidity. Species that grow in the shade and in well-protected spots are, however, not thus armed. Their foliage is soft and delicate, whereas woolly plants—take the Edelweiss and species having smooth, generally thick and glossy leaves—are usually encountered on arid, unsheltered slopes. Flora of altitudes exposed to the heat of the sun generally produces large, brilliantly colored flowers; while that of shaded situations exhibits very small, pale blossoms, entirely out of proportion to the size of the plant. The influence of the sun and its effect on vegetation are more striking here than elsewhere. Annual species, so abundant on lower levels, are rarely met with in Alpine zones. The short summer there does not permit them to accomplish the complete cycle of their existence in a single season. Alpine plants are always branched from the base with perennial rootstock and stems spreading on the ground, whereby the plant secures protection against inclement nights and severe days. All the activity and energy of the plant is brought to bear on the development of the flower and the reproductive organs. Owing to the conditions under which they thrive, Alpine plants require sometimes several years to accomplish the cycle of their existence, and need more than a single season to produce flowers and seeds. The flora of polar countries has a very different aspect from that of the mountains, though many species are common to both. The polar sunlight, though more constant, is less intense and more diffuse than that of the temperate regions in which most of the mountain flora has its home. The effects of the difference are seen in the plants and flowers.

Holy Wells.—Curious superstitions connected with holy wells are illustrated in M. and L. Quiller-Couch's book about those of Cornwall. Many if not all of these wells date as holy from pre-Christian times, and as it was not practicable or even possible to nullify the people's faith in them, the missionaries had to Christianize them by renaming them and dedicating them to some Christian saints, and there are now few English wells that have heathen names. Heathen rites

seem, however, to have lingered round the wells, for it was occasionally necessary in the middle ages to forbid devotions of certain kinds about them. Afterward the reverence for the wells and such practices as bathing crippled children in them and using the water to cure sore eyes, were regarded as papistical. They were supposed to cure illness and madness; if properly interrogated, to reveal the future; and, upon the simple condition of dropping a pin or a piece of money into the water, to secure good fortune to the worshiper. There are still, it is said, wells at the bottom of which pins may be seen. In Portugal, according to Mr. Oswald Crawfurd, the wells are supposed to be haunted by Moorish maidens.

Light-bearing Cephalopods.—An animal of the cuttlefish family, described by Henri Coupin and M. Joubin as *Histioteuthis Bonnetliana*, of bright rose color, has bright red membranes connecting the tentacles, and on the surface of its body yellow and blue spots of various sizes, with a bright point in the middle. These spots, according to Verany, shine while the animal is alive, but lose their glow after it is dead. They consist of a black cup, wide open at the top, with a large convex lens within the opening forming a kind of cover to it. Another round opening serves as a sort of frame to a second lens. A section lengthwise of the organ discloses a parabolic mirror and the two lenses arranged perpendicularly to each other, the whole forming a sort of black cylindrical lantern closed above by a large lens, which casts a light upward, and in front by another lens throwing it out horizontally. Another cephalopod, colored pale blue or violet, so like the sea as to be hardly visible, found in fine weather on the surface of the Mediterranean — the *Chiroteuthis*, a poor swimmer—is provided with special organs in the form of nets that are always spread to attract and capture its food of smaller animals. A series of intensely black vesicles may be perceived on its ventral arms, separated by little transparent suckers armed with a circle of sharp teeth. These vesicles are formed externally of concentric lamellæ and internally of a transparent vesicle, the contents of which have strong refracting powers. While the animal is living, light is decomposed by the concentric lamellæ, and the organs are thereby made iridescent with a silvery metallic luster. Smaller animals are attracted by the glitter of these organs, and are then seized by the suckers, which are kept on guard by the side of them. The suckers of the larger tentacles are incapable by their structure of seizing prey, but are helped, as in the case of these vesicles, by a combination of lure and snare, the lure consisting of highly colored vesicles or chromatosperes, and the snare of a network of waving, anastomosed lamellæ which issues from the cup and spreads itself around as a net. The animal swims slowly along, shaking its tentacles around itself, stretching them out and bending them back so as to keep out in the water around it innumerable lines to catch the little animals as they pass and hold them as if in the jaws of a pincers. A third type of hunting organs in this animal is that of special suckers at the ends of the tentacular arms, each containing a black organ forming a lure, with a well-developed sucker at the end.

A Theory of Sheet Lightning.—In his paper on thunderstorms in India, Prof. Michie Smith says that sheet lightning is seen at Madras every evening for six months, always near the horizon and directed toward the southwest. The time of occurrence varies from day to day, but is always toward evening, and generally not later than nine o'clock. The phenomenon is not a reflection of distant lightning flashes, but consists of an actual discharge of electricity from cloud to cloud or between two portions of the same cloud, and it takes place in the upper portions of low-lying clouds. When morning lightning occurs, its direction is northeast, hence the lightning is always to be looked for in the regions of still air where the land and sea breezes meet. The time of occurrence depends on the hour when the sea breeze sets in, the display being about three hours later than this. Cumulus clouds rise together in pairs and the discharge takes place between them, sometimes possibly within them. The author thinks the electrical conditions of the clouds may be accounted for by the fact that the sea breeze is moist and dusty, while the land breeze is dry and dusty. The presence of dust in the

clouds is shown when they sink rapidly; the dust is then seen at their edges and gives the iridescent or nacreous appearance frequently observed.

Horticulture an Object Lesson in Evolution.—The study of horticulture and agriculture is held up in Garden and Forest as having a distinct value as a factor in furnishing exercise for certain powers of the mind, and as providing in the systematic examination of the principles of those branches training than which no science affords better. Prof. Bailey, in Science, mentions some of the uses and applications of horticulture in discussing the theory of evolution. It shows the development of life in actual operation. More than six thousand species of plants are cultivated, and most of these have been broken up into varied forms by the hand of man. Some species have produced thousands of distinct forms, and the methods of production of many of them are on record. In place of arguments as to the probable influence of climate upon plants, the horticulturist cites definite cases, so that there is no conjecture about the matter. Instead of speculating upon the transmission of acquired characters, the horticulturist furnishes proof of such transmission. Paleontology brings disjointed evidence in regard to the influence of selection and probable changes from environment, while the horticulturist brings examples before our eyes to prove that he can modify and mold vegetation at his will. The horticulturist creates new species, and shows you numbers of cultivated plants of which no one knows the original form, because the ones with which we are acquainted are so unlike the type that the two can never be connected. This is only a single line of inquiry, and other illustrations quite as striking can be given to show that there is an abundant field for scientific research and profound thought in horticultural science as such.

Physical Characteristics of Cuba.—"In Cuba," says Mr. J. W. Spencer, in his paper on the Geographical Evolution of Cuba, "are mountains higher than any on the eastern side of North America; extensive plains as level as those of the Atlantic coast; valleys formed at the base-level of erosion, and deep cañons carved out by the youngest streams; the remains of enormous beds of limestones mostly swept off the country, and coral reefs and mangrove islands extending the coastal plains into the sea; sea cliffs, caves, and terraces of great and little elevation; drowned valleys deeper than the fiords of Norway indenting the margin of the insular mass; caverns innumerable and rivers flowing underground; rifts through mountain ridges and rock basins; tilted, bent, and overturned strata, dislocated and faulted in modern times, so as to make youthful mountain ranges; metamorphic rocks and rocks igneous, and these again altered to secondary products; old base-level plains or those modified and reaching across the island, having insular ridges of older formations rising out of them, and with the surfaces scarcely incised by the streams; residual soils from the decomposition of the rocks and sea-made loams and gravels; in short, so rapidly are the geologic forces working that one can see a greater variety of structure and learn more of dynamic geology in Cuba than on more than half of the temperate continent." The island is seven hundred and fifty miles long and from twenty-five to one hundred and twenty miles wide. In the western part the ridges of mountains culminate in a point with an altitude of twenty-five hundred feet, but the principal topographic relief is along the southern coast of the eastern extension of the island where Pico Tarquino rises from the Sierra Maestra to an elevation of eighty-four hundred feet. The central portion of the island is generally a plain of from two hundred to four hundred feet above tide, which bears many scattered and interrupted ridges like islands in a sea. Mr. Spencer's study is chiefly confined to this part of the island.

A Word in Favor of Woodpeckers.—The food of woodpeckers has been studied, with a view to determining whether they are injurious or beneficial in the economy of apiculture and forestry, by F. E. L. Beal, who concludes that they do far more good in the destruction of insects than harm with the little fruit and grain they eat and the sap they suck. Of seven species considered, the author regards the downy woodpecker as the most beneficial, it being a great eater of in-

jurious insects, while the vegetable food it consumes is of little value to man. The greatest sin we can lay at its door is the dissemination of poison ivy. The hairy woodpecker probably ranks next in point of usefulness. It eats many beetles and caterpillars, few ants, a trifling amount of grain, and for fruits it seeks the forests and swamps, where it finds wild cherries, grapes, and the berries of dogwood and Virginia creeper. It scatters fewer seeds of the poison ivy and poison sumac than the downy woodpecker. The flicker eats more of ants than of any other kind of insects, and very little corn, while fruit constitutes about one fourth its fare, "but the bird depends on Nature and not on man to furnish the supply." Not one of these three birds shows a questionable trait, and they should be protected and encouraged in every possible way. The redhead woodpecker has a pronounced taste for beetles of very large size. Unfortunately, however, its fondness for predaceous beetles must be reckoned against it. It leads in the consumption of grasshoppers, has a taste, but not a very damaging one, for grain, eats largely of wild fruit, and also partakes rather freely of cultivated varieties, especially of the apple; and in some places feeds extensively on beechnuts. The red-bellied woodpecker is more of a vegetarian than any of the others, but, on the other hand, eats many ants and beetles. The yellow-bellied woodpecker seems to show only one questionable trait, in a fondness for the sap and inner bark of trees. This, comparatively harmless in the forest, may be a serious matter in orchards. The pileated woodpecker is more exclusively a forest bird than any of the others, and its food consists of such elements as the woods afford, particularly the larvæ of wood-boring beetles and wild fruits. This species is emphatically a conservator of the forests.

MINOR PARAGRAPHS.

War is defined by M. Ch. Letourneau, in his book on the subject, as having robbery for its object and murder as its means. The author's other numerous books are about the evolution of some social factor or another, but he does not treat of the evolution of war—because, he avers, there is, fundamentally, no evolution of war. It is simply a return to the condition of savagery, an unchaining of all the bloodthirsty inclinations, an awakening of all ferocious appetites—such, he says, war has been in the past, and such it is destined to be in the future. The handling of the transportable material, the conditions accompanying preparation, strategic ingenuity, skill in the conduct of the campaign, diplomacy in fixing the lot of the vanquished—these accompaniments of war have been subjects of evolution; but all war is, and remains, in itself the apologetic manifestation of force—the most flagrant of all crimes—that of *lèse* humanity.

Wooden fishhooks are still in use in the waters of the regions around Bordeaux, France. Two kinds of different types are described. The *hain* is a small piece of broom-wood, spindle-shaped, sharp at both ends and swelled in the middle, about an inch long, and borne by a fishing line tied to the middle. The *clabéon* is a little shorter piece, of hawthorn, pointed at the lower end, with a thorn attached and projecting laterally from the upper end. The fishing line is double, and is fastened to the lower end of the stick and then looped around the base of the thorn. These hooks are in the forms of the most primitive times. Precisely similar ones to the *hain*, but of bone, have been found at the Robenhausen lake station of Wangen, and others of ivory at the cave of Pair-non-Pair, in the Gironde. The other one, the *clabéon*, is like the thorned fishhooks made by the Sakaya negritoes of the Malay Peninsula.

It is observed, in Knowledge, by Mr. Vaughan Cornish that while every one is familiar with the work of the breakers in tearing down cliffs and grinding the fragments into shingle and sand, it may easily escape notice that the formation of cliffs is also the work of the sea. The space through which the breakers act is chiefly that between high and low water mark, between which a sloping shore is cut away so as to form a nearly flat beach, terminated by a cliff. In point of fact, the destruction and

the formation of cliffs are the same process. Sometimes the waves pile up a bank of sand or shingle which protects the cliffs from the direct action of the breakers. The cliff, however, gives way under the actions of wind, rain, and frost; and the material carried down to the base of the cliff by these agencies is removed by the sea, so that the cliff is maintained at an angle steeper than the angle of repose, and is constantly falling. When the jointing lines of a rocky cliff slope downward from the shore line, the waves undermine the cliff, and great masses of superincumbent rock fall by their own weight, as the masses of coal fall in the mine through the skillful undercutting of the collier.

Mr. A. H. Thayer has an article in a recent issue of The Auk entitled The Law which underlies Protective Coloration. In it he sets forth "a beautiful law of Nature which, so far as I can discover, has never been pointed out in print. It is the law of gradation in the coloring of animals, and is responsible for most of the phenomena of protective coloration except those properly called mimicry. Mimicry makes an animal appear to be some other thing, whereas this newly discovered law makes him cease to appear to exist at all. The newly discovered law may be stated thus: Animals are painted by Nature darkest on those parts which tend to be most lighted by the sky's light, and *vice versa*." The author's theory seems to be that Nature, by a careful coloration, effaces the ordinary lights and shadows by means of which a solid body is recognized, and that the various markings which at first sight seem unnecessary are really for the purpose of forming a background such as one might see if the animal were transparent.

A curious instance of protective mimicry combined with intelligence is found in the nest of the dabchick, which, as described by Mr. Harry F. Witherby, is simply a mass of green floating weed common in streams and ponds, like other masses of the same weed, except that it may be a little higher and more compact, but not sufficiently so to enable one to distinguish it. When the white eggs have been laid in it, means of concealment are called for, which the bird provides by covering up the eggs with leaves when it goes away, thus transforming the nest again into apparently nothing more than a floating mass of weed. In a few days the eggs become so covered with dirt that they are exactly of the color of the nest, and do not need even this protection any longer.

The results reached in the report to the London Metropolitan Asylums Board on the use of antitoxine in diphtheria agree substantially with those recorded by observers in various other countries and confirm the favorable opinions. The general reduction in mortality obtained in the metropolitan fever hospitals is less than that claimed in some foreign institutions, but then, the London Times suggests, "there was less room for improvement in the former." In the more dangerous class of cases, and especially in those which came under treatment at an early stage of the disease, the drug fully maintained its reputation. These conclusions were unanimously concurred in by the six medical superintendents constituting the commission of inquiry.

The Third International Congress of Psychology will be held at Munich, August 4 to 7, 1896. All psychologists and all educated persons desiring to further the progress of psychology and to foster personal relations among students of the subject in different nations are invited to take part in the meetings—in which women will enjoy equal consideration with men. German, French, English, and Italian will be the languages used. The programme of the work in the congress is arranged under the general headings of psychophysiology, psychology of the normal individual, psychopathology, and comparative psychology; while the subheadings suggest an extensive range and variety of topics. The subscription price for membership in the congress is fifteen shillings, twenty francs, or about four dollars. Persons intending to present papers—twenty minutes in length—should give due notice of the same, before the beginning of the congress, to the secretary, Dr. Freiherr von Schrenk-Notzing, Munich, Max Josephstrasse, 2.

The growing of flowers to be put into the market as cut flowers has become an important business, and many large gardens are devoted to it in the vicinity of New York.

Growers, Garden and Forest says, who aim to get their flowers to market in the best condition, place the stems in water as soon as the flowers are cut. The flowers are kept in a cool, dark, underground room. The method of cooling by water is considered better than that by the use of ice, as the change of temperature on being taken to the express car is not so violent. The flowers are usually cut when the temperature of the houses is not extremely high, rather in the morning than in the evening. In summer as little time as possible is lost in getting the flowers to market, but in cooler weather some are improved if kept from twelve to twenty-four hours before being packed for shipment. In packing, long, shallow wooden boxes are smoothly lined with newspaper, above which sheets of thin oil paper are laid. The heads are usually placed at each end of the box. On arrival at New York they are taken to the rooms of the Cut Flower Company and there examined and graded according to established rules—roses, for instance, being classified as fancy, extra, first, second, and third.

NOTES.

Since the photographic method of observation was adopted, Prof. Max Wolf, of Heidelberg, has discovered thirty-six asteroids between the orbits of Mars and Jupiter, not one of which has he seen through the telescope.

The total output of gold in the United States in 1895 was approximately $46,740,000. South Africa comes next, and Australasia third, with $45,835,000. Russia shows an increase in output over 1894 of $7,350,000, the 1895 production being $35,405,000. The estimated production in Mexico was $5,835,000.

In recognition of his labors in connection with so eminent an American Institution devoted to the Encouragement of the Arts and Manufactures, and of services rendered to that Government, the French Government has named Dr. William H. Wahl, for many years Secretary of the Franklin Institute, "Officier d'Académie," and has conferred upon him the decoration of the "Palmes Académiques."

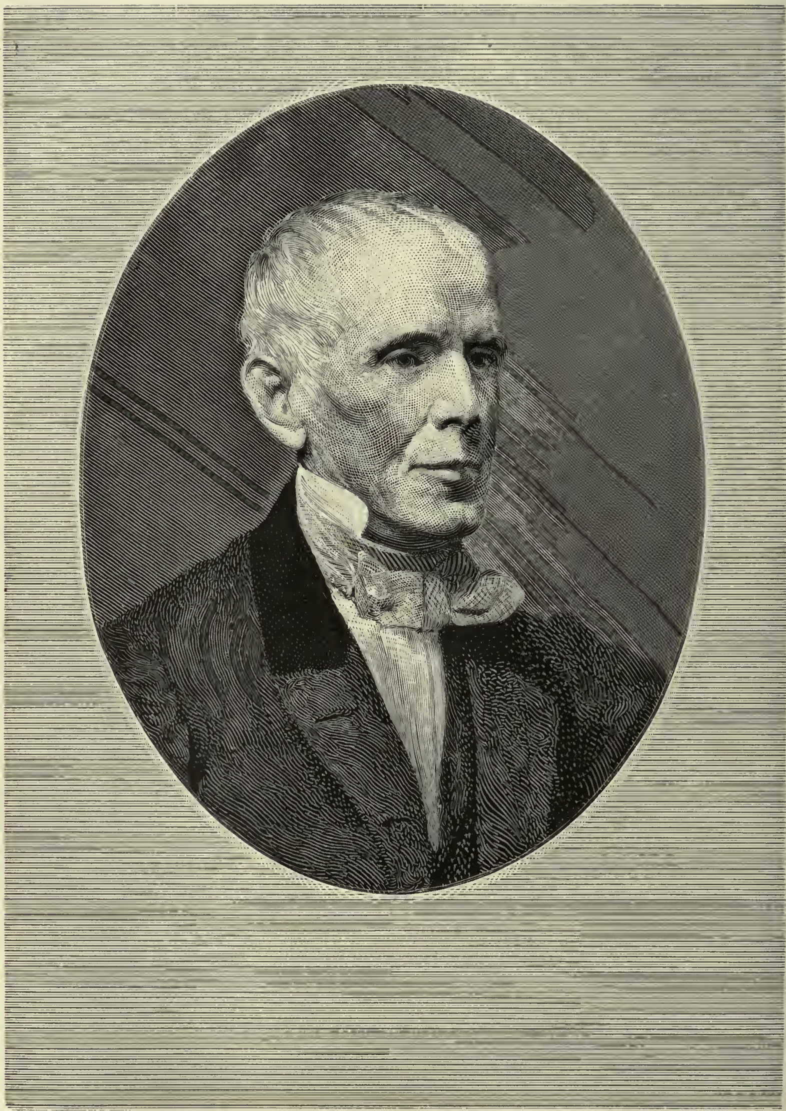
Closing a description of Lake Louise, in the Canadian Rocky Mountains, Mr. Walter D. Wilcox observes that the characteristic features of the region of Mount Temple (11,658 feet high) and of the Canadian Rockies in general, as differentiated from other mountain regions, as the Alps, Andes, and Himalayas, "are found not so much in the geological age and nature of the strata as in the extent and character of those erosive forces which have resulted in forming narrow, deep valleys, often with precipitous rock walls of great height and grandeur, thus making the mountains relatively very high. Added to this, climatic conditions sufficiently moderate in summer to tolerate, and humid enough to encourage, a rich vegetation, there results a fortunate combination of beauty and grandeur which has already begun to attract the attention of travelers. The by no means excessive precipitation of snow is offset by a long period of nearly ten months for accumulation, resulting in extensive glaciation on the higher peaks. As these points are favored by the addition of a clear, cool, and invigorating atmosphere, there is but little doubt that the Canadian Rockies will enjoy an ever-increasing popularity and favor among travelers and mountaineers."

In the numerous scientific balloon ascensions he has executed, Dr. A. Bersen has met all the types of meteorological situations, and has found in all seasons that the temperature at great altitudes diminishes more rapidly than, or at least as rapidly as, at lesser altitudes, and that at heights exceeding seventeen thousand five hundred feet lower temperatures exist than those deduced from Glaisher's ascensions. So the increase in the velocity of currents with the elevation is also larger than has been supposed. A marked preponderance of winds with a westerly component is established for great altitudes—a fact that agrees with the results of cloud observations made from below.

The movement for the introduction of horseless carriages is represented by two periodicals, the Horseless Age and the Motocycle, in the United States; the Autocar, in London; and La Locomotion Automobile and La France Automobile, in France. The Automobile Club of France, organized a few months ago, already counts nearly five hundred members, and has recently opened a hall in one of the most frequented quarters of Paris. It is arranging for races, competitions, exhibitions, conferences, and congresses, and will form a library for the use of its members. The French have bestowed a nickname on the automobilists, and call them *Chauffeurs*, or Warmers.

La Revista Literaria (the Literary Review) is a new bimonthly literary periodical of twenty pages, published at Buenos Ayres, under the editorial direction of Manuel B. Agaste. Office of publication, Peru, 69.

The death of M. Daubrée, the eminent geologist, is announced. He was born in Metz, educated at the Polytechnic School of Paris, and from 1839 to 1855 was a professor at Strasburg University. He was then promoted to a chair at the School of Mines and the Natural History Museum, Paris.



SAMUEL LUTHER DANA.

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PRINCIPLES OF TAXATION.

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III.—THE DEFINITION, OBJECT, AND SPHERE OF TAXATION.

IT would seem to be in the nature of an economic or common-sense axiom, that a large and varied experience in respect to the management of any one of the great departments of the world's business, would result in the gradual evolution and final definite establishment of certain rules or principles, which would be almost universally recognized and accepted as a basis for practical application and procedure. But in respect to the matter of taxation—which is a fundamental necessity for the maintenance not only of all government, but of civilization—no such result has been achieved. In no department of economic science is there, moreover, so much obscurity and conflicting opinion. Most economists teach that there is "no science of taxation as there is a science of exchanges"; and "that there are no great natural laws running through and controlling taxation and its effects." And while the student will find examples in the history of states or governments of the practical application of almost every form of appropriation of private property under the name of taxation which human ingenuity, prompted by necessity, selfishness, or greed, could devise,* and a sufficient record

* "In Austria everything, it is said, is taxed except the air, and even that has to be paid for in places famous for their salubrity. Dogs, cycles, newspapers, advertisements, and innumerable other articles—pleasures and necessaries—are included in the money-producing list; nothing, indeed, seemed excluded until a very short time ago, when a provincial financier forwarded an exhaustive report to the finance ministry on a neglected source of

of effects to warrant the drawing of general and correct inferences, it is nevertheless probably true that there is not, at the present time, a single existing tax, decreed by despotism, or authorized by the representatives of the taxpayers, which has been primarily adopted, or enacted *solely* with reference to any economic principles, or which has sought to establish the largest practical conformity under concurrent circumstances to what are acknowledged to be the fundamental principles of equity, justice, and rational liberty. But, on the contrary, the influence of temporary circumstances, as viewed, in most instances, from the standpoint of a governmental administration—despotic or republican alike—desirous of retaining power, has ever been the controlling motive in determining the character of taxation; or, as Colbert, the celebrated finance minister of Louis XIV, is reported to have expressed it, in saying that "the art of taxation consists in so plucking the goose [i. e., the people] as to procure the largest quantity of feathers with the least possible amount of squawking." Hence, apart from its methods of distributing power and patronage, the popular idea of evil, as connected with government, may almost always be referred back to unequal or excessive exactions; and to the reality of which, as evils, more than to any other one agency, may be referred most of the world's political revolutions, and the ferocity with which, as was notably the case in France, they have been often conducted. Hence,

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revenue—cats. The horse, the ass, the goat, the hog, the chicken, the dog, the goose—all contribute their mites to the support of the state, said this financial reformer. The cat alone is a parasite, paying nothing to any one and preying upon every one. But is the project really practicable? Certainly it is, replies its author, and he forthwith sets himself to prove it. Every cat for which the tax—a rather heavy sum—is paid, would receive an official colored ribbon for its neck, with a number and a government stamp. Every feline defaulter found without this ribbon would be seized and temporarily confined in the Cats' Home. If not redeemed before the lapse of a fixed term—say eight days—it would be sold or poisoned by the state."

"A tax on beards was in operation for a long time and under various forms in Russia. Peter the Great, knowing the attachment that his subjects had for the hirsute adornment of the face, introduced a tax upon the beard in his empire. The beard is a superfluous and useless ornament, said he, and, starting from this principle, he imposed a tax upon it as an article of luxury. This tax was proportional and progressive, not in proportion to the length of the beard, but to the social position of those who wore it. Each person upon paying his tax received a token, which he had to carry upon his person, for the guards were nexorable, and, always provided with scissors, ruthlessly cut off the beard of those who could not show their badge."

"Catharine I confirmed this tax. In 1728 Peter II allowed the peasants to wear a beard, but kept up the tax for the other classes under the penalty of work on the galleys in the case of non-payment. Czarina Anne rendered life still harder to bearded men, for not only were they obliged to pay the special contribution imposed upon them, but also had to pay a double tax upon everything else for which they were assessed. This tax was not abolished until the reign of Catharine II (1762–1798)."

also, the preference almost always shown, on the part alike of those who enact and those who pay taxes, for *indirect* taxation, which very successfully blinds the taxpayer as to the amount which he pays and as to the time and place of its collection; and hence, finally, the idea, which has come to be all but universally entertained, that taxation *per se* is in itself an evil—something to be avoided, if possible, and an escape from which is always "good fortune."

A QUESTION OF PRIME IMPORTANCE, therefore, which confronts us at the outset in entering upon any discussion of this subject is, Are these assumptions of economists that there is no science of taxation and no general laws regulating its exercise and effects —assumptions generally concurred in by jurists and popular sentiment—correct? If they are, then there are no principles of taxation to discuss, and a consideration of the subject must be limited mainly to a recital of the world's experiments and experiences and an exposition of legislative enactments and court decisions. To admit their correctness, furthermore, is equivalent to confessing that human knowledge, in at least one department, has reached its extreme limit; and that a class of transactions which, more than almost any other, are determinative of the distribution of wealth, the forms in which industry shall be exerted, and the sphere of personal liberty, are best directed by accident or caprice. To ascertain the true state of the case ought, accordingly, to constitute the main object of inquiry, and, with a view of helping to the formation of an intelligent opinion, attention will be first asked to the meaning or definition of the two fundamental terms, *tax* and *taxation*. And in so doing we obtain immediately an illustration of the indefiniteness of idea and lack of exactitude in expression that characterize this whole subject, and also a very definite clew to their origin.

ANALYSIS OF THE WORD TAX.—Thus, the word *tax* in the English language, and its equivalent in all other languages, is used in a very loose and indefinite sense. Many writers, and the dictionary-makers generally, use the word in an extremely generic sense, to cover and designate all contributions obtained by process of assessment and levy (act of collection) by a state or government from the persons and property of its citizens; or from persons and property within its power and jurisdiction; in whatever form, or however arbitrary the assessments or levies may be, and by whatever name they may be known or designated—whether tribute, toll, talliage, duty, gabel, customs, impost, poll, subsidy, aid, excise, income, or benevolence.* Such a

* "A tax is a rate or sum of money assessed on the person or property of a citizen by Government for the use of the nation or State."—*Webster's Dictionary.*

definition, however, which makes no distinction between contributions levied at his unrestrained will or caprice, and for any purpose, by a bandit whom circumstances have raised to the head and government of a petty tribe or community; or by an absolute and ignorant Oriental potentate, like Ismail Pasha, Khedive of Egypt (1863–'79); * or by a European monarch, like Louis XIV, who said, "I am the state," and those contributions which represent that part of the wealth of a state which is taken from its citizens with their free consent for exclusive public purposes, in accordance with a well-defined and intelligent public policy; a definition that recognizes no distinction between these two methods and objects of taking, obviously can not be scientifically correct; for there can be no more analogy between the two methods than between a payment for value received and an act of highway robbery.† Obviously, also, there can be no science of taxation predicated or formulated on such a definition, for there can be no science of irregularity and arbitrary action.

Again: "So long as people use words which have no precise signification, which may be interpreted in a variety of ways, and which present at once to the mind different ideas more or less obscure, more or less mixed up with one another, there will be uncertainty in the theory, or rather there will be a vague, incomplete, and ill-co-ordinated theory; and then, as all practice is the application of a theory, the practice resulting from it will be faulty."—*M. Menier.*

The celebrated French economist above quoted also makes the following well-warranted criticism on the current definitions of taxation: "They have," he says, "one general fault: they try to point out the employment of taxes, but they do not show the origin of taxes."

What, then, will be a correct definition of a tax?

"The definition of both Webster (Daniel) and Story (Justice) is, that a tax is a contribution imposed *by Government* on individuals for the service of the State."—*Miller, on the Constitution of the United States*, p. 235.

"Taxes are defined as the enforced proportional contribution of persons and property levied *by the authority of the State* for the support of the Government and for all public needs."—*Cooley on Taxation*, p. 1.

"A tax is a portion, or the value of a portion, of the property or labor of individuals taken from them by Government and placed at its disposal."—*J. R. McCulloch.*

* The revenue annually exacted, under the name of taxation, by Ismail Pasha, especially during the latter years of his reign, from an exceedingly poor population a little in excess of five million in number, was reported to have been about $75,000,000.

† Despotic rulers in all ages of the type of Louis XIV, the Khedives of Egypt, the Sultans of Turkey, and the Czars of Russia have undoubtedly regarded their expenditures of money exacted under the name of taxation from their subjects for the maintenance of great armies, harems, mistresses, pensions to favorites, and the like, as for legitimate public purposes.

It is not easy to frame such an one, in clear and succinct language, covering all the essential conditions. It probably never has been done, and therefore the best thing to do is not to spend time and effort in attempting it, but rather to endeavor to illustrate and point out its meaning indirectly. And, with this purpose in view, it is important to recognize at the outset an exact and homely truth, and one which heretofore has been generally overlooked by writers on taxation and political economy, namely:

That a government never has any money—by which alone the expenses of the state can be defrayed—except what the people—citizens or subjects—give, or concede to it by voluntary or involuntary action; and that the people, as a whole and in turn, never have any to give except what comes to them as the result of their work, or from an exchange of the products of their work. And such being the case, it follows, as has been happily pointed out by Mr. Atkinson, that what the Government really wants of its people, when it calls upon them for taxes, is work, and that the methods of taxation are only methods for collecting and using the products of work.* Hence the following definition of a *tax*, deduced from the above statement of fact by Mr. Atkinson—that "*it is that certain portion of the product of a country which must be devoted to the support of the Government*"—embodies a meaning and a truth not incorporated and set forth in the ordinary or popular definitions. At the same time it is deficient in not recognizing any distinction between a just and uniform taking and an exaction or confiscation.

TAXATION IN THE UNITED STATES, ITS AGGREGATE AND DISTRIBUTION.—During the year 1890 the aggregate revenue receipts of the several governments of the United States, derived mainly from taxation, as reported by the census of that year,† were $1,039,482,013, apportioned as follows: Federal taxation, $461,184,-680; State taxation, $578,328,333. The last aggregate was again subdivided into $116,157,640 for State purposes, including the Territories and District of Columbia, $133,525,493 for county pur-

* "Taxation means work, of the head, of the hand, or of the machine, or all combined. And the method of taxation is only a method of distributing the products of work. It is measured, when in the process of distribution, in terms of money, but the money itself stands for work, or is derived from work. And the work of the Government is as much a part of the work of the community as any other. All who work, from the head of the nation down to the lowest municipal official, must be supplied with shelter, food, and clothing; and those who pay the taxes do the work that is necessary to furnish this supply."—*The Industrial Progress of the Nation, Edward Atkinson;* Putnam, New York, 1890. *Taxation and Work, same author.*

† The census of 1890 presented for the first time even an approximation of the annual incomes of the several governments of the United States, and the amount and objects for which they were expended.

poses, and $329,635,200 for municipalities and schools. If a temporary and extraordinary charge for pensions—$140,959,361 in 1895—which now rests upon the Federal Government, were eliminated, and Federal expenditures were reduced correspondingly, the taxation and expenditures of the national or Federal Government would be small in comparison with the total cost of all government, Federal and State; a result that constitutes a complete refutation of the common assumption that the national Government is rapidly absorbing the functions of the State and local governments and reducing them substantially to police precincts. Of the Federal revenues, nearly one half under the existing fiscal system are derived from taxes on distilled spirits, fermented liquors, and tobacco, all of which may be fairly regarded as self-imposed.

If we assume, as we are probably warranted in doing, the average value of the product of each person in the country *who is occupied for gain*, at six hundred dollars per year,* or two dollars per day for three hundred working days, then that part of the annual product of the country which went to the support of its Government or the State in 1890 was the equivalent of the work of 1,734,121 such persons for one year, or 520,236,300 days' work; or, in other words, for every dollar that the Government expends, somebody must work for at least half a day, or furnish a value equivalent for such an amount of work. Again, for the year 1890, the aggregate of taxation in the United States—national, State, and local—required or represented about seven per cent of the value of the entire annual product of the country, which probably approximated $1,200,000,000. In former days it was often customary to allow persons to pay their taxes by actual days' work, and this is still the practice in some parts of the United States and in Canada and some countries of Europe. Before the French Revolution, the tax imposed on the French peasantry, and known under the name of *corvée*, as has been already shown, was an obligation to render a specified number of days' work to the state, or to some seignior or noble. During the early colonial days of Massachusetts, the people of the settlements far removed from Massachusetts Bay paid their proportion of the expense of maintaining a colonial government at Boston in wheat, which was shipped down the Connecticut River in canoes, and then transferred to sailing craft and transported by sea to Boston. One could hardly imagine the disturbance and excitement that would be occasioned if all the taxes of the country were to be collected in this

* The most recent investigations of Mr. Atkinson, the best authority on this subject, have led him to the conclusion that the average value of the product of each person in the United States, working for gain three hundred days in the year, was in 1890 nearer $700 than $600 per annum.

way, and if the head of every family was compelled to perform annually some twenty days' labor to discharge the obligation incumbent on himself and family to pay taxes, which would be about the amount which the head of every family in the United States would have to perform to meet its present annual expenditures. Everybody would then be talking economy; and the politician who wanted votes, instead of promising public buildings, or more salaried offices to his constituents, would say, "Gentlemen, give me your votes and elect me, and I will have your compulsory labor cut down next year from twenty-five days to twenty, or even fifteen." And yet the difference between that state of things and the present is merely a difference of appearance.

WHAT IS TAXATION?—The popular or dictionary definition of taxation—namely, "the act of levying a tax or imposing taxes"—is as indefinite and imperfect as the ordinary definition of a "tax" has been shown to be. Scientifically considered, taxation *is the taking* or appropriating such portion of the product or property of a country or community as is necessary for the support of its government, by methods that are not in the nature of extortions, punishments, or confiscations; and a systematic and orderly arrangement and presentation of the knowledge gained by experience and discussion, with a view to effect such a result with certainty, uniformity, and the minimum of cost and trouble to society and its individual taxpayers or contributors, constitutes the *Science of Taxation.**

In what will be hereafter said, the word *taxation* will be used as far as possible in the sense in which it has been defined; but at the same time the employment of the unscientific term has become so general that its use in default of any satisfactory synonym is almost unavoidable, especially in the historical treatment of the subject.

Such a limitation of the meaning and nature of the word *tax* as has thus been given is clearly of the first importance, and a lack of its recognition is undoubtedly responsible in a high degree for the present unsatisfactory position of the subject of taxation as a department of economic knowledge; and also for a very general belief that in determining the forms of taxes the only rule to be followed is that of expediency. It may be too much to claim that a general recognition and practical acceptance of the proposed definitions and limitations are absolute essentials for the concep-

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* Essentially the same definition of taxation has been given by Mr. J. R. McCulloch. "It is," he says, "the name given to the branch of the science of political economy which explains the mode in which different taxes affect the public interest, and in which the revenue required for the public service may be most advantageously raised."—*Treatise on the Principles of Taxation, J. R. McCulloch, 1875.*

tion and construction of any just and intelligent system of taxation, and also for any such collocation of general truths relative to taxation as will raise the subject to the dignity of a science. But, be this as it may, it seems certain that such recognition and acceptance would at once sweep away many obstacles that would otherwise stand in the way of such a consummation, and bring a high degree of order into what is now a comparative chaos.

And, as one illustration of this, consider how entirely, and yet how naturally, the proposed definitions and limitations change the generally accepted idea of the relation of a tax to the individual taxpayer.

As has been already pointed out, the popular idea of a tax is that it is always an evil. Most writers also on political economy, in discussing the subject, start with the idea that the act or exercise of taxation necessarily implies perpetual antagonism between the state, the sovereign, or the executive, and the private citizen. The parties concerned are the citizen on the one side and the state on the other, and the former being comparatively weak and the latter exceedingly strong, the state is always assumed to get the upper hand. M. Proudhon, in his work *Théorie de l'Impôt* maintains that "all taxes are iniquitous," and that "if a sole tax was established it would be the sum of fiscal iniquities." "There are no taxes," says Ricardo, "which have not a tendency to lessen the power to accumulate." J. B. Say, the eminent French economist, declared that, by whatever name known, taxes are always a burden upon the private citizen. M. Garnier, another French economist, defines taxes "as the reduction made on the private fortunes of the citizens by the Government to meet public expenditures." According to John Stuart Mill, "it is impossible in a poor country to impose any tax which will not impede the increase in the national wealth."

"None of us feel, when the tax-gatherer comes, that to be taxed is a favor; or that, as to the money exacted, we as individuals are the better off for its having been taken from us. We know the tax is a burden; as such it is recognized by every person upon whom it is imposed."—*Hon. Thomas M. Cooley.*

All such conceptions of the position of the state in respect to the taxpayer are, however, monarchical, implying the relation of master and subject, lord and serf;* and from such a point of view

* When the Jewish people, weary of the tax despotism of a sacerdotal class—i. e., the tribe of Levi, to whom the land was held to have been given by Jehovah—manifested an intention of setting up a king, the prophet Samuel foretold that under royalty taxation would be still more oppressive, and "this," he said, "will be the manner of the king that shall reign over you. He will take your sons and appoint them for himself, and set them to ear his ground and reap his harvest; and he will take your daughters to be cooks," etc.; "and your fields, and your vineyards, and your olive-yards, even the best of them; and the

this general idea of antagonism between the taxpayer and the government is correct and has been in accord with the great mass of the world's experiences. In fact, these conceptions undoubtedly originated with the first or old economists, who, living under arbitrary, despotic governments, and unable to comprehend the modern ideas respecting personal liberty and a free government, came to the only conclusion respecting the nature of taxation that their limited sphere of observation and experience would permit.* And so to-day, under an absolute government, the interests of the sovereign—czar, sultan, emperor, king, whatever name he bears—are always in a greater or less degree in antagonism to those of the nation, and these same conceptions have also to a large extent been generally accepted in states whose form of government is not monarchical, but free or popular, as in the United States, where, through lack of intelligence or interest on the part of the general public and of the law-makers, systems for raising revenues have been built up and tolerated which almost without exception are unjust in their administration and incidence. When an eminent lawyer and member of the Constitutional Convention of the State of New York in 1867–'68 stood up before that assemblage when the subject of taxation was under consideration and said, "I insist that a people can not prosper whose officers either work or tell lies—there is not an assessment roll now made out in this State that does not both tell and work lies," † no man gainsaid him, for no man who had ever given any attention to the subject could.

But such conceptions are not true of taxes levied under a popular form of government, and in accordance with conditions essential to justify their right to be called taxes; for there is no one act which can be performed by a community which brings in so large return to the credit of civilization and general happiness as the judicious expenditure, for public purposes, of a fair percentage of the general wealth raised by an equitable system

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tenth of your seed, of your sheep, and your goodliest young men and put them to his work," etc. And the prediction then made was verified, as under like circumstances it has always since been.

* With the old economists the state always preponderates. It is the master of the citizen instead of being merely the steward of the nation. "It addresses the citizens imperiously. They are its *contributables*, and must pay. According to such doctrine, life is a tollgate. They must give so much a head for the right of living in the country. Man is the debtor of the state. Man pays, not the commodity, and the citizen remains the serf of the state."

"Under monarchical right, taxation is speculation by the king upon the people. In a word, there is an antagonism between those who pay and those who levy taxes. Taxation is the expression of that antagonism."—*M. Menier.*

† Speech of Hon. M. I. Townsend, Delegate at Large, Constitutional Convention of New York, 1867–'68. Proceedings and Debates, vol. iii, p. 1945.

of taxation. The fruits of such expenditure are general education and general health; improved roads, diminished expenses of transportation, and security for life and property. And it will be found to be a general rule that no high degree of civilization can be maintained in a community, and indeed that no highly civilized community can exist, without comparatively large taxation;* the converse of this proposition, however, at the same time not being admitted, that the existence of high taxes is necessarily a sign of high civilization.

It is interesting to note, however, that as civilization increases, and taxation becomes absolutely greater, it also becomes relatively less. Thus, in most of our great cities the cost of the water supply to its inhabitants constitutes at present one of the largest items of municipal expenditure—an item that forty or fifty years ago hardly found a place in municipal accounts. And yet the cost of a supply of even the minimum quantity of water now regarded as essential to meet the ordinary requirements for personal cleanliness and health would be very much greater to every citizen, were he to undertake to supply himself, even if it were possible, by the old methods; to say nothing of the comfort and luxury, as well as protection against loss by fire, which an increased supply, made possible only through a greatly increased aggregate of taxation, has afforded.

In short, taxation assessed and levied under conditions clearly conformable to reason and justice, is no more of an evil than any other necessary and desirable form of expenditure. Its proper exercise does not diminish, but protects and augments, national wealth, and is no more a burden upon the people of a state than the payments made for the care and profitable management of private or corporate investments of capital are a burden upon the owners of such capital. Indeed, M. Menier, whose study of taxation entitles him to be regarded as an authority, contends that the analogy between the expenditures of a state which have to be remunerated by taxes and the expenditures of a manufacturer is most complete. The state, he says, possesses a certain extent of territory. That territory has such and such natural utilities. These natural utilities have been developed by labor

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* "I have not seen an instance of rent being very low, and husbandry at the same time being good."—*Lowe, quoted by McCulloch.*

"It is universally found that the low rents absorb the largest proportion of the product."—*H. C. Carey, On Wealth, p. 341.*

"An ingenious philosopher has calculated the universal measure of the public impositions by the degrees of freedom or servitude that accompany them, and ventures to assert that, according to an invariable law of Nature, it must always increase with the former and diminish in a just proportion to the latter."—*Statement by Gibbon, on the authority of Montesquieu.*

or appropriated by man, and the capital of the nation is the *ensemble* (the whole) of the utilities it possesses. In the case of a private person the conditions are the same. His capital is the *ensemble* of the utilities he possesses. The result which he, equally with the state, seeks to attain, is the same—namely, to make the capital which they control fructify to the greatest possible extent for the benefit of the citizens of the state on the one hand and the individual on the other; and between the expenditures which it is necessary to incur for the attainment of these ends on the part of the state and the individual there is no essential difference. And from this analogy, thus urged to identity, M. Menier deduces the following definition of taxes:

They represent, he says, *the investment of the capital of the nation, or state, and the general expenses of its care and development.**

It is obvious, however, that M. Menier's analogy would not hold good under a system which failed to recognize any difference between a tax and an arbitrary exaction.

"So far as it is necessary for the security of person and property, money spent for the support of government is as usefully expended as is the purchase of clothing or provisions; but when the sum taken exceeds what is required for that purpose, it is only a question of amount between the sovereign of India, who exacts one half of the produce, and the legislator of Great Britain or the United States, who exacts a million of pounds or of dollars for which an equivalent is not given."—*H. C. Carey, On Wealth, p. 343; Philadelphia, 1888.*

An almost self-evident corollary from these sound deductions would be, that any tax or system of taxation that did not protect but diminished private property would tend to imperil or dry up the sources of public revenue.

A recognition of the true relation which a just and equitable system of taxation sustains to the state and to the capital or property of its citizens, and also of the fact that under such a system a tax *works to a diminution of the income of the property taxed, and not to a diminution of the value of the property itself,* ought

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* M. Menier, in proposing the above definition, himself recognized the necessity of accompanying it with the following explanation: "When I say that taxes 'represent the investment of national capital,' it is of course understood that I speak only of that of the investment assigned to the state, and that I am very far from the communistic theory, according to which the state, being the owner of the national capital, should turn it to account for its own profit. In the useful employment of the capitals of the nation there are an individual part and a collective part. In my definition of taxes only that collective part, the syndicate contribution, is taken into account."—*A Treatise on the Taxation of Fixed Capital, by M. Menier, of the French Chamber of Deputies. English translation, by I. O. Gallegan, Fellow of the University of France; London, 1880.*

to effectually expose the fallacy of the somewhat popular idea, that taxation is really a *gradual* (and in the course of time a complete) confiscation by the public of all private or individual property; and that in a certain sense no man by reason of taxation can be regarded as having a perpetual ownership of any property; an annual tax on the value of any property of one and a half per cent, with five per cent interest, exhausting such value in about *thirty* years. If taxation brought no returns, either direct or indirect, to the persons or property assessed, there would be some warrant for regarding it as an act of confiscation; but if it provides, as every correct system of taxation does, for a certain class of expenditures, in default of which in the present state of society there would be no adequate protection to property and no encouragement for its accumulation and development, then there is no more reason for regarding taxation as confiscation than for attributing the same effect to payments for wages, rents, repairs, interest,* insurance, etc.

A practical illustration of the truth of this conclusion is to be found in the circumstance, that as a rule the class of property paying the highest proportional taxes in any community is the most profitable or desirable to its owners. It is also a pertinent question, why property which has paid taxes for a given period—say thirty years—and has so been absorbed by the public, should continue to be assessed; or why, if the person popularly regarded as the owner of such property should refuse to pay taxes, the property should be sold for taxes when it has already been taken to itself by the public.

Another point of interest in connection with this subject which has been little noticed by economists is, that if a high degree of civilization can not exist without a high degree of taxation,† the methods of economizing labor, or, what is the same thing, of producing a greater amount of product with a given amount of labor—conditions which make high civilization possible—enable a government progressive in this respect continually to take a larger share of the results of the work of its citizens, expressed in terms of money, without really increasing their burdens of taxation. "Every invention and discovery by which the production of commodities is facilitated and their value

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* This same fallacy was indeed applied to interest in the United States, when an eminent official maintained that in paying interest for many years on the public debt the people of the country had more than paid off the principal, and were therefore morally justified in repudiating the debt.

† Year by year the public demands more efficient schools, better postal facilities, better harbors, improved paving, drainage, and lighting of streets, a stricter abatement of nuisances and supervision of infectious disease. All this means a higher standard of public well-being, entailing, however, constantly increased public outlay.

reduced, enables individuals to spare a larger quantity for the use of the state. The sacrifice made in paying taxes, consists in the labor, or in the cost of the money or produce required to pay them and not in the amount of such money or produce." A given, amount of food and clothing, iron, steel, copper, leather goods, paper, and transportation can now, for example, be furnished to the Government of the United States for at least one third, and probably not more than one fifth, of the labor required to produce like quantities of these same commodities or services in 1840; while the wages paid for the work which such quantities represent or necessitate have been increased from fifty to seventy-five per cent and upward. In 1840 an operative in the cotton mills of Rhode Island, working thirteen to fourteen hours a day, turned off 9,600 yards of standard sheeting in a year; in 1886 the operative in the same mill made about 30,000 yards, working ten hours a day. In 1840 the wages were $176 a year; in 1886 the wages were $285 a year.

During the ten years from 1870 to 1880 the increase in the number of hands employed in anthracite coal mining was 32·2 per cent, as compared with an increase of product of 82·8 per cent; while in the case of copper during the same period the ratios were 15·8 and 70·8 per cent respectively. The whole tendency, therefore, of the modern conditions of production is not to entail any greater sacrifice on the part of the taxpayers for the support of the Government, but rather to diminish it. "Governments have precisely the same interest as their subjects in facilitating production, inasmuch as its increased facility affords the means of adding to the quantity of produce at their disposal without really adding to the weight of taxation; whereas, on the contrary, a diminished facility of production must either diminish in an equal degree the produce appropriated by government or compel it to lay heavier burdens on its subjects. Public wealth, in short, is merely a portion of private wealth transferred to government, and the greater the amount of the latter the greater, of course, will be the magnitude of the portion that may be conveniently spared for public purposes."—*J. R. McCulloch.*

WHEN TAXATION BECOMES AN EVIL.—It is not pretended that taxation, even under a correct system of assessment and collection, may not under some circumstances be an evil. It is an evil when through extraordinary or injudicious expenditures of the state it is excessive and demands too large a proportion of the annual or concurrent income of the people (in the form of rents, interest, profits, salaries, and wages), out of which, or out of the *annually* augmented wealth of a country, and not out of accumulated capital, all taxes ought to be paid, and as a rule are paid. The economic rule governing taxation of first importance

laid down by Prof. Cossa (*Scienza delle Finanze*) is "that it should, when possible, tax income only, whether national or individual, but spare the estate itself."

If the burden of taxation, or the amount taken, is not fully compensated by increased production or increased saving, it becomes one of the greatest evils to which a people can be subjected; for under such circumstances the means of future production will be impaired, encroached upon, and the country will necessarily begin to retrograde.

When the share of the annual product falling to the workmen of any country is barely sufficient to support life free of taxation, then the burden of taxes begins to promote pauperism. It takes that which is necessary to existence and the maintenance of energy. This is now occurring in Italy. The taxation of Italy probably absorbs more than one third part of the product of the country. The army is served first, the workmen second, while the women become diseased and the children die by lack of adequate nourishment.

Taxation is also an evil, though in a lesser degree, when the rate assessed is not the same upon all persons, property, and business within the same sphere of (business) competition; when it is made an instrumentality for effecting some other purpose than that of raising revenue, no matter how desirable that purpose may be; and when, as in the United States, it is largely indirect, and its incidence and amount are thereby concealed from the ultimate taxpayers.*

The general result of experience is also to the effect that when excessive and exceptional taxation has been resorted to by a state for the purpose of regulating or destroying industries or traffic, it has rarely been successful. The economic and moral lesson

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* A most interesting and instructive example of the decay in modern times of a considerable state due to radically vicious methods of collecting revenue is afforded by the present condition of the Asiatic kingdom of Persia. Its typical despotic government, represented by the Shah, annually demands and exacts a large amount of money from its subjects to defray the expenses of the state, but not more, perhaps, than the resources of the country and its people would fairly warrant and sustain, if it was collected by intelligent methods. In default, however, of any knowledge of how to get revenue without destroying the springs of wealth, the method of taxing is so irregular both as to time and rate, and so thoroughly unjust and unequal, as to impair the value and security of property, prevent accumulation and free use of capital, and discourage commerce. A British expert has recently reported to his home government that if a qualified European or American could be placed at the head of the exchequer at Teheran, who was allowed such control that no penny exacted from the people of the state should be absorbed on its way to the treasury, or be taken save in due course of law, he might yet save Persia and drain into it a new and vigorous Asiatic population, who would fill its now deserted but fertile plains, and organize a commerce in which all the world stood ready to participate and furnish the instrumentalities necessary for its development.

deducible from such experience may be briefly summarized as follows:

Whenever a government imposes a tax on any product of industry so high as to sufficiently indemnify and reward an illicit or illegal production of the same, then such product will be illicitly or illegally manufactured; and when that point is reached, the losses and penalties consequent upon detection and conviction—no matter how great may be the one or how severe the other—will be counted in by the offenders as a part of the necessary expenses of their business; and the business, if forcibly suppressed in one locality, will inevitably be renewed and continued in some other. It is therefore a matter of the first importance for every government, in framing laws for the assessment and collection of taxes, to endeavor to determine, not only for fiscal but also for moral purposes, when the maximum revenue point in the case of each tax is reached, and to recognize that in going beyond that point the government "overreaches" or cheats itself.

Increase the duties (taxes) on imports beyond a certain point, and smuggling springs up as by magic, and the most cruel and unusual punishments utterly fail to prevent it. American ingenuity was never more fertile or manifested in a more remarkable manner than in the evasion during the years 1864–'68 of a tax, approximating fifteen hundred per centum, imposed by the Federal Government on the manufacture and sale of distilled spirits, resulting in a complete failure on the part of the Government, with almost unlimited military resources at command, to enforce the law, and a final abandonment and repeal of the tax.* The comparatively recent tax imposed by the United States on oleomargarine, with a view of destroying its manufacture and preventing its use as an article of food, has been so far ineffectual that its production and consumption have been greater than they were before the law authorizing the tax was enacted.

More than a century ago Adam Smith pointed out that such taxes "tempt persons to violate the laws of their country, who are frequently incapable of violating those of natural justice, and who would have been in every respect excellent citizens had not those laws made that a crime which Nature never meant to be so."

Some other fallacies concerning the sphere and influence of

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* Out of a consumption of at least fifty million proof gallons of distilled spirits of domestic production in the United States during the fiscal year 1867–'68, the Federal Government collected a tax upon less than seven million gallons, the sale of the difference at the current market rates of the year, less the average cost of production, returning to the credit of corruption a sum approximating sixty million dollars.

taxation which have obtained popular credence may be here appropriately noticed.

Thus, it is not infrequently assumed that any injurious influences of excessive or unnecessary taxation are largely or wholly imaginary, inasmuch as they are really returned to the contributors (taxpayers) through the expenditures of Government; which, by increasing demand for commodities and services, create or extend markets, maintain prices, and enlarge the sphere or opportunity for industrial employment, and favor an increase in the supply and circulation of money. This assumption is obviously but a reproduction in another form of the fallacy (before noticed) that industry can be stimulated by taxation; and which in turn finds its antetype in a favorite idea of the middle ages that the destruction or waste of commodities "made good for trade"; and which maxim, it is said, a guild of glaziers in Paris practically carried out by encouraging their apprentices to break windows, who may have attempted to justify their conduct by asking themselves the question, "What would become of the glazing business if nobody ever broke windows?"

A general answer to this fallacy is, that to break, spoil, or *waste* by fire, pestilence, war, famine, shipwreck, or injudicious and unnecessary taxation and public expenditure, always entails a loss to society; and if these results give to certain class interests an opportunity to perform unnecessary work, or sell products at an advance over their current prices in the world's market, and thereby inflict unnecessary and additional taxes on other individuals, it can not be regarded as other than an evil, and prejudicial to public interests.

To those who live on the produce of *unnecessary* taxation and correlative governmental expenditure, any consequent encouragement of industry by increasing demand and extension of markets, will very naturally seem to be in the highest degree beneficial. But, in order that industry may be truly benefited, the market must be real and not artificial, or one created by unnecessary taxation and expenditure. "It is absurd to suppose that either individuals or states should receive the smallest benefit from the demand of those whom they have been previously and unnecessarily obliged to furnish with the means of buying. To keep up useless regiments and overgrown establishments on the pretense of encouraging industry is quite as irrational as if a shopkeeper were to attempt to increase his business and get rich by furnishing his customers with money to buy his goods."—*McCulloch.*

Hamilton (a Scotch economist) puts the case even more forcibly. "To argue," he says, "that the money raised in taxes, being spent among those who pay it, is therefore no loss to them, is no less

absurd than the defense of a housebreaker, who, being convicted of carrying off a merchant's money, should plead that he did him no injury, for the money would be returned to him in the purchase of the commodities in which he dealt."

"It is obvious that the services rendered by the various public functionaries who receive the proceeds of taxation form the only return made to the taxpayers. And it is undoubtedly true that these services are of the highest value, and that, when neither the number nor the salaries of those by whom they are rendered are unnecessarily large, they constitute a full and ample equivalent for the sums expended upon them. But all beyond this—all that is drawn from the people by means of taxes, to be expended in maintaining unnecessary functionaries, or in overpaying them—is wholly lost to the taxpayers, or is not in any way compensated to them."—*McCulloch.*

"We might as well say that it would be a good thing to put snags in the rivers, to fell trees across the roads, to dull all our tools, as to say that unnecessary taxation could work a blessing." —*Prof. W. G. Sumner.*

Some writers of repute have advocated the special imposition of taxes on the ground that they act as stimulants to industry. M. Garnier entertained this opinion. The late J. R. McCulloch, who wrote learnedly on the Principles of Taxation, favored such practice on the part of government, provided the taxation was "*moderate.*" But of taxation employed for such object which was not moderate he wrote as follows:

"The effect of exorbitant taxes is not to stimulate industry, but to destroy it. The stimulus given by excessive taxation to industry has been not inaptly compared to the stimulus given by the lash to the slave—a stimulus which the experience of all ages and nations has proved to be as ineffectual as it is inhuman, when compared to that which the expectation of improving his condition gives to the productive energies of the citizen of the free state."

The direct beneficial agency, not merely of moderate but of most excessive taxation, as a stimulant to industry, is also obviously a fundamental principle in every so-called "protective tariff system."

Very curiously, the best refutation of these ideas was made by the late H. C. Carey, in a Treatise on Wealth, published in 1838. After indorsing the statement of Mr. McCulloch as to the influence of exorbitant taxation on industry, and the correctness of his analogy between the stimulus afforded thereby and that imparted by the lash, he antagonizes the proposition that the effect of even *moderate* taxation imposed as a stimulus to industry can be in any degree beneficial, by asserting that what is true of the influence

of exorbitant taxation in this respect "is equally true of all unnecessary burdens (of taxation), whether great or small."

"If taxation be a stimulus," he says, "the advantage must increase with its extent, and taking 2*s*. per week must do more good than taking 1*s*. Moderation depends upon habit. We think Mr. McCulloch has fallen into the same error with the man who attributes increased vigor to two glasses of brandy, while he deprecates the drinking of a quart as likely to produce intoxication. The man in sound health who drinks two glasses will not work as well as he who drinks none, but he will do so much better than his neighbors who drink by the quart that it may be supposed that his superiority results from the glasses taken, when it really arises out of the six that he has forborne to take. If taxation be good, so is the lash: both will make people work, but neither will make them work well. The moment we admit that taxation in any case tends to promote industry, it is impossible to say where we shall stop."

Another fallacy which has obtained credence, especially in recent years in the United States and even among its legislators, is that the burden of taxation is increased by a fall in the prices of commodities which represent the work that furnishes the money with which taxes are paid. It owes its existence and tolerance to the non-recognition of a principle of taxation which has also been thus set forth by Mr. J. R. McCulloch:

"The amount of a tax is not to be estimated by the *bulk* or *species* of the produce which it transfers from individuals to government or to creditors in general, *but exclusively by its value.* A heavy tax consists in the abstraction of a large value, and a light taxation in the abstraction of a small value. When a fall takes place in the cost of producing any article, its price necessarily declines in an equal degree, and its producers are obliged to dispose of a proportionally larger quantity to obtain the means of obtaining the same amount of taxes. But it is an obvious error to suppose, as is very commonly done, that the burden of taxation is consequently increased. The value paid by contributors remains the same, and it is by values and not by quantities that the weight of taxation is to be measured. If through improvements in agriculture, machinery, or any other cause, two quarters of wheat or two yards of cloth were produced with the same expenditure of capital and labor that is now required to produce one quarter or one yard, it would be no hardship to give double the quantity of wheat or cloth in payment of taxes."

A failure to recognize and understand this principle has led to much erroneous reasoning on the subject of taxation, and finds a curious practical illustration in the following record of recent experience. Thus in the so-called bimetallic discussion in the

United States it has been unqualifiedly asserted that, owing to the remarkable decline in the average prices of general commodities (estimated at about eighteen per cent from 1867 to 1877, and thirty-one per cent from 1867–'77 to 1886–'88), and which in turn has been assumed to have been occasioned by the demonetization of silver and consequent appreciation in the value or purchasing power of gold, the burden of the national debt of the United States and also all private debts, especially such as are in the nature of mortgages on land or on other productive fixed capital, has been greatly increased, inasmuch as a greater effort of labor or an increased amount of the products of labor—typically cotton and iron—had become necessary to liquidate such debts and the interest thereon.* The error in such reasoning or assumption is found in the circumstance that no consideration is given or allowance made for the different results of labor at the periods of price comparisons, and that the *real* cost of producing the staple commodities of the United States, or the effort needed to produce a given amount of general merchandise, or the number of days' work put into each piece of such merchandise, has on an average decreased during these periods more than their market prices have decreased, so that instead of the decline in the prices of commodities under consideration having increased the burden upon labor of national and other debts created before such decline, the burden has been lessened to just the extent that the average cost of producing commodities has declined to a greater degree than their average market prices. Thus all authorities are substantially agreed that there are few departments of industrial effort in which the saving of time and work in the twenty to thirty years next anterior to 1890 was at least forty per cent, and in not a few instances has been much greater (in the manufacture of boots and shoes, for example, eighty per cent). In North Carolina the relative increase in cotton product and population from 1870 to 1880 was as 4·5 to 1. With slight changes in the relation of labor to product, the cotton crop of the United States increased seventy-six per cent between the years 1866 and 1872, and forty-nine per cent between 1872 and 1886. Recent investigations have shown, in the case of certain leading articles in hardware, that a given quantity which represented a labor cost in

* In 1885 a memorial signed by ninety-five members of the United States House of Representatives of the Forty-eighth Congress and presented to the President of the United States contained the following statement: "Eighteen million bales of cotton were the equivalent in value of the entire interest-bearing national debt in 1865 ($2,221,000,000); but it will take thirty-five million bales at the price of cotton now (1885) to pay the remainder of such debt ($1,196,000,000). Twenty-five million tons of bar iron would have paid the whole debt ($2,674,000,000) in 1865; it will now take thirty-five million tons to pay what remains ($1,375,000,000) after all that has been paid."

1870 of a million dollars could be afforded in 1894 for a like cost of $444,444. Another striking illustration of the present cheapness of manufactured articles per unit and as measured in terms of labor payments per hour or day, compared with former recent periods, and as the result of present industrial conditions, is found in the statement that wire nails are now so cheap that, if a carpenter drops a nail, it is cheaper to let it lie than take time to pick it up; and the correctness of which has been demonstrated as follows: "Assuming that it takes a carpenter ten seconds to pick up a nail which he has dropped, and that his time is worth thirty cents per hour, the recovery of the dropped nail would cost 0·083 cent. There are two hundred sixpenny nails in a pound, and they are worth on an average 1·55 cent per pound, making the value of one nail 0·0077 cent. In other words, it would not pay to pick up ten nails at the assumed loss of time and rate of pay of the carpenter."

On the other hand, wages have increased in the United States since 1870 in an approximative ratio with the increase in the effectiveness of labor in producing commodities, and touched the highest point ever known about the year 1890. During the same period debtors have gained greatly by the decrease in the cost of living, and a consequently increased opportunity for laying up a surplus for meeting tax demands and other purposes. The assumption that the comparatively recent fall in the price of commodities in the United States has increased the burden of taxation upon its people, therefore merits the characterization of being one of the most irrational and fictitious of popular economic fallacies.

Some interesting facts concerning the Hausas and their country in Africa were communicated to a recent meeting of the Royal Geographical Society by Mr. J. A. Robinson and Mr. William Wallace. Mr. Robinson has paid much attention to the language and literature of the people. Nearly all of them have learned to write in the Mohammedan schools, and business is largely done by correspondence. An association has been formed to promote the study of the language; and a college is talked of to be established at Tripoli. Mr. Robinson has brought back specimens of native literature, of which a volume is to be published. Crops of many kinds are raised, of which Mr. Wallace names fourteen specifically, with others; and large stocks of horses are kept. At Farra, the chief seat of the iron trade, Mr. Wallace visited the smelting furnaces, but was not allowed to see the mines from which the iron ore is dug. At Jaga he found an important commercial town, with large pottery works and dye works, and industries in iron and leather. A part of the country, which was once very prosperous, is, however, now a retreat for robbers, who keep the neighboring region in terror. Mr. Wallace affirmed that peace and freedom only are needed to convert Hausaland into another India.

THE SYMPSYCHOGRAPH: A STUDY IN IMPRESSIONIST PHYSICS.

By DAVID STARR JORDAN.

THE Astral Camera Club of Alcalde was organized in November, 1895, for purposes of scientific research through the medium of photography. The function of the club was the coöperative study of man's latent psychical powers, that these might be made helpful in the conduct of life. No powers granted to man should be neglected or allowed to waste in idleness. Just as the great physical force of electricity remained for centuries hidden, and known only by casual and unimportant manifestations, so the great odic forces within man still are scantily revealed. The method of the club in Alcalde was to be that of the most rigid scientific research. It was to take up, one after another, the discoveries of our eager century as they were made known to the world through the medium of the daily newspaper. To these were to be added those suggestions which alert intuition and psychic practicality would naturally suggest. No hypothesis in science was to be rejected beforehand, and no prejudice was to stand in the way of the reception of any new theory that might contain a living truth.

As soon as the news of the marvelous experiments of Prof. Röntgen had reached Alcalde, the Camera Club began work on the X rays, and on the larger problem of the significance of photography without visible light. They had no difficulty in repeating the usual experiments. They got an outline of the skeleton of a canary, the shadow of an empty pocketbook, the bones of a finger surrounded by a gold ring, and the location of an imbedded shot. Thus those strange rays of light, or odic force, invisible to our eyes, because none of our ancestors ever had a chance to gaze upon them, disclosed the presence of objects which had else lain forever in darkness. In addition to this, the green light of the vacuum tubes provoked that uncanny feeling which always precedes and presages a great discovery in occult science. From this feeling the club was safe in predicting that far greater discoveries were to follow, and that the X rays would not end in mere repetitions of Röntgen's triumphs in "skiography."

In this they were not disappointed. Prof. Inglis Rogers, of London, found that not only could pictures be produced in darkness by means of invisible force, but that the invisible waves sent out through the ether by the mind could also affect a sensitive plate. Just as one sensitive mind at a distance receives an image sent out from the psychic retina of another, so could the same image be concentrated and fixed upon a photographic plate. Prof.

Rogers in a matter-of-fact way looked for a few minutes at a postage stamp, then retired to a dark room, and gazed through the lens of the camera at the sensitive plate. The figure of the postage stamp was on his mind, and from his mind it passed out through the sensitive ether to the plate made ready to receive it. The result was a photograph of the stamp—small and a little blurred, but showing the undoubted features of the gracious Queen and the words "one penny." Thus was the bridge between psychic power and photographic sensitiveness made once for all. This connection established, there is naturally no limit to the application of the principle.

It thus becomes plain that the invisible rays of Röntgen are not light in the common sense, but akin rather to the brain emanations, or odic forces, which pass from mind to mind without the intervention of forms of gross matter as a medium, and to which gross matter in all its forms is subject.

Nor is this principle new in the philosophy of man. The wise of all ages have held that mind is sovereign over matter. Besides this general law, it has been known to our fathers that in the eye of the dying man is impressed the last scene on which he looked in life. With instruments of precision we may examine that scene, and by skillful photography we should be able to secure and fix it for all time. Whittier foreshadows the broad law on which this rests when he asks:

> Do pictures of all the ages live
> On Nature's infinite negative,
> Whence half in sport, in malice half,
> She throws at times, with shudder or laugh,
> Phantom and shadow in photograph?

It may be that by means of such negatives History is able to repeat herself. It is not unlikely that among the latent powers which are conferred upon man by the possession of the astral body, are those which will enable him to read the pictures on the infinite negatives of Nature, and by that means to rescue the records of the vanished past.

Following the experiments of Prof. Rogers, other physicists have tried to photograph the psychical images as they are impressed on the retina by the force of imagination. It is evident that such images are distinct from those arising from immediate contact with reality; but their real nature is the same in essence. When Inglis Rogers was gazing at the stamp he saw only an image on the retina, and in reality it was not on the material cells of the retina itself that the image rested, but it was on the *tabula rasa* of the mind. It was outward from the mind itself, not from the retina, that this was projected through the sensitive and responsive ether to the sensitive plate of photography, an arrange-

ment of unstable cells which is the triumph of the art of the chemist.

It is therefore not necessary for this experiment that one should gaze at an individual stamp. To think of a stamp will serve as well. Recognizing this fact, Mr. Cameron Lee, another English experimenter, attempted to secure the image of a thought. Placing his own eye in the focus of a lens in absolute darkness, he thought intensely of the face of a certain cat. After a long exposure, necessary on account of the comparative grossness of the photographic materials, a picture was formed. The negative shows a rounded outline evidently that of the enlarged pupil of the eye, and in its center was formed a faint image, which could be mistaken for nothing other than a cat. An account of this experiment was given in the daily press, but its true bearing was first seen at Alcalde.

At the meeting of the Astral Camera Club held in Alcalde on April 1st of this current year, its president, Mr. Asa Marvin, read a paper on these discoveries, calling attention to their astral significance. The supremacy of mind over matter, already indicated in a hundred ways, was thus splendidly illustrated. As a thousand miles of ether may be made to vibrate at the command of the will of the psychical adept, so may the grosser forms of matter be shaken or removed when this subtle and resistless force acts upon it.

The famous legend of Odin and the Golden Mead, as Mr. Marvin went on to show, is not a myth, but was probably an actual occurrence. It may be a reality again when Odin's descendants rival their ancestor in that wisdom for which the famous hero so freely gave his right eye. It is not unlikely that the actual Niffelheim, or mist-home, where he exchanged his right eye for wisdom, is to be sought in the Himalayas rather than in Scandinavia. Odin, it will be remembered, after he had gained this wisdom, wished a draught of the golden mead which the giant Suttung kept locked up in his strong house of stone near his castle of Spukheim. Odin had arranged with the giant Bauge, whose hay he had harvested, that he should help him to secure this life-giving drink. And thus, the saga tells us, when they had found the stone castle in which the mead was hidden, Odin and Bauge sat down all day before the stone wall and gazed steadily upon it. By this means, so the story goes, they bored a small hole through the stone large enough for Odin in the astral form of an angleworm to pass through, and by this means the mead was gained and the strength of the giants passed over to mortals.

The essence of this story lies in its illustration of the power of mind over matter when its forces are concentrated. By psychic intensity the cohesion of molecules of gross matter may be over-

come. It is well known to physicists that these molecules nowhere actually touch each other, nor do they come near doing so. The spaces between them are filled up by ether. Into the interstices of the ether it is easy for the odic force to introduce itself. It is, in fact, unlikely that the gross particles of stone exist at all; for, as some physicists have shown, these are but eddies or vortex-rings in the ether itself, which is the only material reality.

Mr. Marvin showed very clearly that this supposed legend was not lightly to be set aside as mythology; or, rather, that it is likely that mythology is the only true history. The same psychic strength and wisdom which have caused Odin to be remembered and revered as a god by our ancestors, was the same psychic force by which he overcame the cohesion of matter. For us all to do this is doubtless only a question of time. Many adepts are already able to do more wonderful things than these. In time the evolution of man will bring these latent powers to light, superseding our common reason with astral intuition as reason has supplanted mere animal instinct.

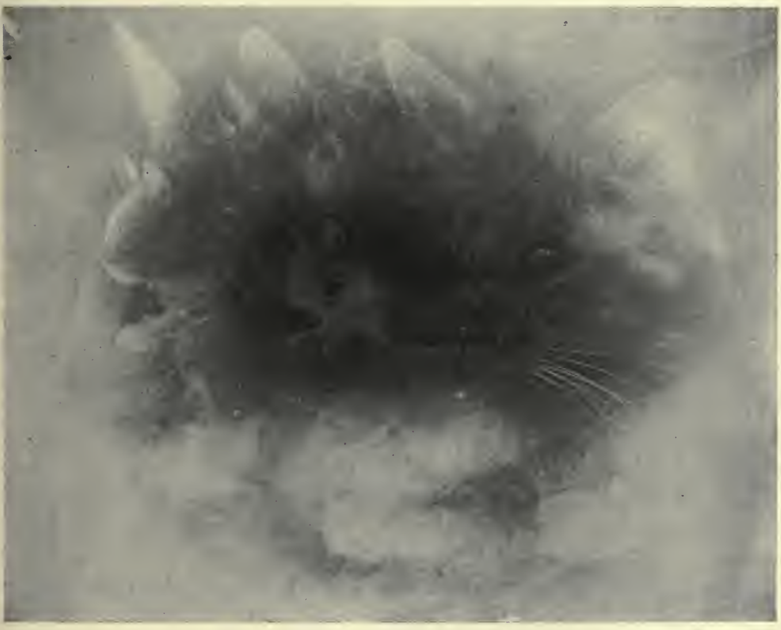
Having thus shown the broad principles on which studies in the new psycho-physics must rest, Mr. Marvin described a special contrivance or application of these principles to the work of the Camera Club.

He had devised a camera with a lens having curved facets arranged on the plan of the eye of the fly. To each one of the seven facets led an insulated tube provided within by an electric connection, so that electric or odic impulses could be transferred from the brain or retina through the eye of each different observer to the many-faced lens. From the lens these impulses would be converged on a sensitive plate, as the rays of light are gathered together in ordinary photography.

From the members of the Camera Club, seven of those having greatest animal magnetism and greatest power of mental concentration were chosen for the experiment. Connection was made from the eye of these observers to the corresponding parts of the lens; then all were to remain in utter darkness and perfect silence, each person fixing his mind on a cat. They were not to think of any particular cat, but of a cat as represented by the innate idea of the mind or ego itself. This was highly important, for the purpose of Mr. Marvin was not simply to fix by photography an ephemeral recollection, as Mr. Rogers and Mr. Lee had done; it was to bring out the impression of ultimate feline reality. The innate image in the mind was the object desired. One man's thought of a cat would be individual, ephemeral, a recollection of some cat which he had some time seen, and which by the mind's eye would be seen again. From seven ideals, sympathetically combined, the true cat would be developed. This combina-

tion is the essence of *sympsychography*, a term suggested by Prof. Amos Gridley, of Alcalde, as distinct from the ordinary ideography of Rogers and Lee. The personal equation would be measurably eliminated in sympsychography, while the cat of the human innate idea, the astral cat, the cat which "never was on sea or land," but in accordance with which all cats have been brought into incarnation, would be more or less perfectly disclosed.

In accordance with this plan the experiment was tried under the direction of Mr. Asa Martin. By the courtesy of the secretary of the club, Miss Corintha Jones, of Alcalde, we are enabled



to present a copy of the resultant sympsychograph in advance of the publication of the regular bulletin of the society in which the apparatus used is figured in detail (see Plate 10).

It will be noticed that this picture is unmistakably one of a cat. But it is a cat in its real essence, the type cat as distinguished from human impressions of individual cats. This achievement, like the earlier ones of Odin, Röntgen, Rogers, and Lee, opens great vistas for future scientific research. The next experiment will be by similar means to photograph the cat's idea of man.

As might be expected in a first attempt, there is a lack of coordination of the parts. Mr. Gridley, the schoolmaster, had

planned his cat on a large scale, a huge cat face with gray radiant whiskers looking directly at the beholder. Most of the others thought of the cat in lateral view or profile. These variant and vagrant individual impressions naturally appeared on the camera before the ether waves were co-ordinated and the reflex influences came back from all to one, regulating and co-ordinating the thought of the cat. Thus these preliminary impressions are recorded as ghost pictures in various places about the plate before the ultimate composite view was achieved. The delay in this regard has darkened the center picture, interfering a little with its perfection of definition. This darkening would probably appear in other experiments on account of the long exposure (sixteen minutes) thought necessary for a picture of this kind, in which odic magnetism is made to take the place of light.

On the cat's cheek is a curious black spot or stigma which has not been fully accounted for. From its sharpness of definition it must stand in some relation to each of the seven persons whose thoughts were centered upon it. One suggestion was that this was the blind spot on the retina in each of the sympsychographers. But the blind spot marks the point of entrance of the nerve which goes back to the brain. While it may not have visual power, it is not unlikely that it is a point of special activity in ideography. This suggests that the black stigma may be the yellow spot, or the *macula lutea*, the point of acute vision, a region on the retina where odic forces would naturally be absent. Mr. Marvin himself inclines to the opinion that a microscopic examination of the negative will show that this stigma has likewise the form of a cat, and that it will be found to be an ideomorphic germ or centrum where the co-ordinate thought of the cat has first impinged on the plate and from which the image of the cat has concentrically arisen.

Meanwhile the cat of Mr. Thompson, the janitor, who alone could answer this question, lay in the darkness under the warm stove and purred softly.

Enumerating the uses made of the fan in Japan, Mrs. C. M. Salney says that the seven gifts of a Japanese bride to her spouse invariably include a fan—in fact, fans are the most frequent gifts in Japan, and are used to present gifts upon. They are much employed for juggling; singers modulate their voices with fans; they have served as news sheets—sometimes as seditious news sheets—and as vehicles of satire. Maps for travelers are printed on fans. Ceremonial fans are employed when houses and other buildings are finished. The fans made for the Japanese themselves are usually not the same as those intended for the Western market. The Japanese prefer smaller fans, quieter in tone and color, and more refined than those that Europeans like.

SOME MODERN VIEWS OF THE CELL.

By JAMES ELLIS HUMPHREY.

HARDLY more than a generation ago naturalists were forming, under the lead of the great Englishman, those conceptions of organic development and of the blood relationship of living beings resulting from common descent which have formed the starting point of almost all subsequent research. During the same years in which Mr. Darwin was accumulating the facts which were to form the imperishable foundations of his superstructure, various German investigators were gradually recording the observations that have afforded equally secure grounds for that view of the essential substance of living organisms which found expression at about the same time with the development theory, and which has exercised a hardly less profound influence upon biological investigation—the *protoplasm* theory.

But the beginnings of our knowledge of the intimate structure of plants and animals reach back two centuries further to the work of an English physicist and optician, Robert Hooke. This man, desiring to demonstrate his improvements in the manufacture of magnifying glasses, published in a volume entitled Micrographia, or some Physiological Descriptions of Minute Bodies made by Magnifying Glasses, in 1667, accounts of the appearance of various objects when viewed with his lenses. Among the objects upon which he had chanced was a piece of cork, and this he found to consist of a series of empty cavities separated by thin partitions, to which cavities he gave the name of *cells*, from their suggestion of the cells of a honeycomb. But although we now know that cork is a dead issue which no longer contains any essential component of the living cells, and although our conception of a cell is to-day quite opposed to that of a tightly closed chamber, such as the name implies, yet Hooke's name, given so long ago to the dead shell, is still retained for the living reality. And here we have one more example of the operation of that interesting conservatism of the human mind which perpetuates established terms or customs or beliefs long after their original fitness and *raison d'être* have been outgrown.

Hooke's work was only one phase of the extraordinary scientific activity that characterized his time. The first fruit of the splendid awakening of the human mind from the paralysis of scholasticism which we owe to the Baconian philosophy was a zeal for the study of Nature; and from this period date some of the most brilliant discoveries in natural science. It is a notable coincidence that in the year 1671 there were presented to the lately established, but already famous, Royal Society of London

two elaborate treatises on the minute structure of plants, which had been quite independently worked out, the one by Grew, an Englishman, the other by Malpighi, an Italian. But their admirable work remained for more than a hundred years the standard of knowledge in plant anatomy, while the overwhelming authority and example of the Linnæan school reduced botany to the superficial examination of dried fragments, and comprised all needed knowledge of a plant in the determination of its Latin name.

For the beginnings of our real knowledge of the cell we must, then, leap the chasm of a century and a half to come again upon a period of improvement of the microscope as affording the means for further advance. In this case the important discoveries of Amici, resulting in lens systems in which both chromatic and spherical aberration were largely corrected, offered to histologists far better tools than had hitherto been at their command. Grew and Malpighi had distinguished in plants two kinds of elements, approximately isodiametric *cells* and much elongated *vessels*; but Treviranus had shown, early in the present century, that vessels are derived from rows of cells by the obliteration of intervening walls. And about the same time he had rediscovered the now familiar circulation in the gigantic cells of the brittleworts, or *Characeæ*, which, first described in 1772 by Corti, had been forgotten in the zeal for taxonomy which possessed his contemporaries. But gradually the idea grew that the contents within the walls of the cell are of importance; that the real cell is a living thing which nourishes itself and grows. One of the earliest clear expressions of this idea was written by Meyen in 1830, who spoke of cells of higher plants as "little plantlets in the greater." But the general spread of such views and general interest in cell problems date from the time when Schleiden's clear mind was turned upon them. Going directly to the heart of the whole matter as it then stood, he asked, "How do cells arise?" and set himself to answer the question. As a probable clew to its solution he seized, by a happy inspiration, upon the discovery made a few years before by Robert Brown that the cells of certain plants studied by him contained each a rounded, rather highly refractive body, which he had called, and which is still called, the *nucleus*. Demonstrating, with the aid of others, the very general occurrence of this structure in plant cells, Schleiden made it the center of his theories of cell life and cell formation. It is true that his belief that new nuclei are formed by a sort of crystallization out of a mother-liquor and then form centers for the formation of new cells, has been proved to be incorrect. And it is equally true that his idea of the cell as a closed chamber filled with fluid, whose wall is its most essential part, is no longer entertained.

Yet the fact that his theories turned attention to the cell contents also, and the fact that the most conspicuous object in almost any animal cell is its nucleus, made these most fruitful in their results, as other mistaken theories have often been. The analogy between plant and animal cells, suggested by the presence of nuclei in both, led Schwann to thorough and profound investigations of animal tissues, in which he happily recognized the fundamental importance of the study of the development of a tissue for the elucidation of its nature. In this way he showed that animal tissues are made up of elementary units comparable with the cells of plants. The final recognition by Schleiden and Schwann, at the end of the fourth decade of the century, that all organisms consist wholly of cells and the products of their activity laid the solid foundations of the cell theory and brought animals and plants into new and most suggestive relations.

Studies of the nucleus had necessarily drawn attention to the granular substance which surrounds it and more or less completely fills the cavity of the cell, and it had already been called "plant mucus" by Schleiden. In 1844 Naegeli determined it to be a nitrogenous substance, and, together with von Mohl, recognized its presence in all living plant cells, while the latter botanist, two years later, first called it *protoplasm*, or primitive substance. Up to this time the leading naturalists believed in impassable barriers and inherent differences between plants and animals. One of these supposed distinctions was the rigid and immotile character of plants as compared with the motile and contractile power of animals. The special contractile substance of animals, which was recognized as homogeneous or finely granular and albuminous, had already been called "sarcode" by Dujardin. But when, in 1850, Cohn showed that some plant cells possess no membrane and that their protoplasm shows the contractility and other supposedly characteristic properties of sarcode, he felt justified in saying with much certainty that "the protoplasm of the botanists and the contractile substance of the zoölogists, if not identical, must yet be structures in a high degree analogous." But this conclusion, expressed incidentally in a paper on another subject, did not receive the attention it deserved. It was not until thirteen years later, when the way had been prepared by the work of De Bary on the Slime Molds and of Haeckel on the Radiolarians, that biologists were convinced by Max Schulze's masterly discussion of the subject of the identity of the substances in question. With the new view of the identity of all living substance went a radical change in the conception of the cell. The cell membrane, which is rarely present in animals, was relegated to the list of unessential constituents, and the vital center was transferred in mind to the cell contents, where it has

been, in fact, since the beginning. The kernel of the new protoplasm theory, which, as before stated, has since dominated research, is contained in Schulze's definition of a cell as "a lump of protoplasm endowed with the properties of life." Yet for a few years some botanists found it difficult to give up the old idea of the active participation of the cell wall in the life of the cell, until Sachs's classic studies removed the last basis for such belief.

We have seen that Schleiden and Schwann recognized that it is only cells and their products which make up the substance of all organisms, but that their ideas of how cells arise were quite erroneous. It was soon observed by von Mohl and Naegeli that cells multiply by the division of those already present, and botanists soon came to the conclusion that plant cells can only come from previously existing ones. This conclusion was reached much more slowly for animals, since it presented many difficulties in the field of pathology, especially in connection with such processes as the formation of pus. But gradually the objections were shown to be of no weight, and the great pathologist Virchow, in 1858, gave expression to the result in the aphorism, "*Omnis cellula e cellula.*"

It will be noticed that the view of the cell current thirty years ago laid less stress upon the nucleus than that of twenty-five years earlier; and we shall see that more importance is attached to it to-day than ever before. Yet, so far as it went, Schulze's view of the nucleus was better than Schleiden's, for it recognized it as a specially differentiated organ of the protoplasm, though knowledge of its particular relations to the activity of the cell was very meager. Up to about 1875 it was generally thought by zoölogists that, before the cell divides, the nucleus is constricted into two portions, one of which forms the nucleus of each of the new cells. The botanists, on the contrary, generally believed that the nucleus disappears before cell division, after which a new one appears in each new cell. These conclusions had been reached by studies of living dividing cells. Practically nothing had been done with preserved material, since no one trusted results so obtained or believed it possible to guard against artificial appearances due to the action of the preservative medium. The introduction of alcohol by Strasburger for killing and preserving tissues, and the proof by comparison with fresh material that no destructive or misleading changes are produced by it, mark the beginning of the epoch of cell studies, which has been characterized by a most astounding development of technical methods for killing, preserving, staining, and sectioning tissues of every sort with the least possible alteration in their living structure. The results of the first profound studies of the nucleus are contained in two volumes which laid the foundations for all future

cell work—that of Strasburger on plant cells, which appeared in three editions from 1875 to 1880, and that of Flemming on animal cells, published in 1882. These authors showed that in both plants and animals cell division is ordinarily preceded by nuclear division. This latter process is not usually a mere constriction, but is, as we shall see, a highly remarkable and significant one, with a wonderful agreement in detail throughout both animal and vegetable kingdoms, so far as studied. The literature of the past fifteen years concerning this subject is of almost incredible volume, but it has all served to confirm the prime importance of the nucleus as an organ of the cell, and to show the correctness of Flemming's extension to the nucleus of the principle long before established for the cell, in writing "*Omnis nucleus e nucleo.*"

While we attribute to the main mass of the protoplasm outside of the nucleus less specialization than to the latter, there appears to be a certain portion of it which has a special rôle. As early as 1883 the Belgian zoölogist, Van Beneden observed that certain tiny protoplasmic masses bear a definite relation to nuclear division, and he expressed his belief that these should be regarded as definite organs of the cell. This view has steadily gained ground, and, although they were not recognized in plant cells until 1891, when Guignard discovered them, on account of their minute size and of the technical difficulties connected with making them visible, their general occurrence and importance may now be said to be well established. These tiniest of the known organs of the cell are called *centrospheres*. Each consists of a central point surrounded by a mass of apparently homogeneous hyaline protoplasm.

Having now traced the development of our ideas, we are prepared to express our present conception of a typical cell as a mass of living protoplasm within which are differentiated a nucleus and one or two centrospheres. Many plants and animals consist of single cells, while others are built up of millions of these units of structure; but any organism is either an independent cell or an aggregation of cells more or less mutually interdependent. Some of the simplest unicellular organisms, like the *Bacteria*, of whose work in the world we now hear so much, are so minute that no differentiation within the cell has been observed. But rapid improvement in methods of study and means for observation are steadily reducing the number of these. Let us try, then, to get an idea of the best-established facts and views concerning the activities of the cell, and as to the part played by each of its organs in these activities.

Most plant cells are inclosed, as we have seen, in a firm wall, usually composed of a substance known as cellulose. Animal cells are, as a rule, without a definite membrane, and it is not cer-

tain that, in any case where a wall does exist, it consists of true cellulose.

The protoplasm of a cell is usually bounded at its outside by a denser hyaline layer which is very impermeable for fluids while living, and thus serves as a protection against the penetration of foreign or harmful substances into the cell. But this outer layer appears also to be the receptive portion of the protoplasm which is sensitive to and transmits external stimuli. Within it is the rather fluid, undifferentiated, granular protoplasm which constitutes the basis of the cell, and in which lie the special organs of which we have spoken. This wonderful mixture of albuminoid or proteid substances, which has well been called "the physical basis of life," must therefore possess those fundamental properties of living things, the power to assimilate, to grow, and to respond to external stimuli; and it is easy to show that living protoplasm possesses all these properties. But the one which most interests us just here is that of *assimilation*. This power of converting food into its own substance, which may result in the increase of that substance, or growth, seems specially to belong to the granular protoplasm, which may be regarded as the nutritive organ of the cell. Just here we note that the food which may thus be assimilated must be organic substance. It may be proteid, like albumin, casein, or fibrin; it may be a carbohydrate, like sugar or starch; it may be a hydrocarbon, such as fat or oil; but organic it must be. Whence comes now the supply of food? Plainly, in most cases, by absorption from without. In animals the solids and fluids taken in are reduced by digestion to the fluid form, and are then transported to the various cells of the organism, to be absorbed and assimilated by them. In those plants known as *fungi*, which can develop only on living or dead organisms, the food materials are absorbed in fluid form, being sometimes first reduced to that form by the action of a ferment secreted by the fungus. But certain cells of most plants have the power of manufacturing their own food from inorganic materials, and thus of living independently of other living things. Thus the green plants bridge over the chasm between the inorganic and the organic, and the life of all organized beings is practically contingent on their life. In the granular protoplasm of some cells of these plants may be found differentiated protoplasmic masses which contain the green pigment *chlorophyll*, that gives them their color. First recognized early in the present century, these masses were observed by Naegeli, in 1846, to increase by division, and therefore to constitute living organs of the cells in which they occur. These chlorophyll bodies possess the synthetic power of recombining the elements of simple compounds obtained from the air and the soil, in the presence of light, into complex organic

compounds which can serve the organism as food. Thus plant cells which contain chlorophyll bodies differ from all other cells in manufacturing their own food and in not being obliged to obtain it from without. Since in all or nearly all plants the lack of chlorophyll, when it is lacking, is due to degeneration in consequence of the acquirement of a saprophytic or parasitic mode of life, the possession of chlorophyll bodies and the consequent food-forming power constitute the most real distinction which separates plants from animals. Treated understandingly, this affords the most satisfying response to the ever-recurring demand for a statement of the differences between the two organic kingdoms, although the distinction is no more an absolute one, as shown by the case of the *fungi*, than any of the other less important ones often suggested.

We have seen that most plant cells possess firm walls, and it is little more than a decade since plants were generally believed to consist of blocks of protoplasm quite shut off from each other, in most cases, by the surrounding walls. The many difficulties entailed by such belief, and the impossibility of explaining the transfer of substance or the transmission of stimuli in certain tissues, was the chief incentive to Gardiner's researches. This author and others after him have shown that, in most tissues, and especially just where they are needed to explain observed phenomena, tiny threads of protoplasm penetrate the cell walls, connecting the protoplasmic masses of neighboring cells and forming the means of communication between them. So that we no longer think of the cells of a multicellular plant as isolated masses of protoplasm, but as connected masses, while the intervening walls give the necessary rigidity and resistance to the tissue.

Passing now to the *nucleus* of the cell, we find a complicated structure. Surrounded by undifferentiated protoplasm, it is bounded against it by a very delicate "nuclear membrane." Within this is a loose network of somewhat solid substance, whose meshes are believed to be filled by a clear, structureless fluid. In this lie one or more small globular masses of a very strongly refractive substance, known as *nucleoli*. That the nucleus is the controlling organ in the more active cell processes is indicated by many facts. It has been found that a cell from which the nucleus has been removed is unable to grow or to form new cell wall. In cells in which growth or any active process is taking place at some definite point, the nucleus takes a position near to that point, although thus lying far from the center of the cell. Any shifting of the point of greatest activity is accompanied by a corresponding change in the position of the nucleus. The centrospheres lie ordinarily close beside the nucleus and play their chief rôle in connection with its division, which we may proceed to discuss.

We have already seen how the conclusion was reached that cells can arise only from pre-existing cells, and that this occurs usually by division. Under favorable circumstances, when a growing cell has reached a certain rather indefinite limit of size, it proceeds to divide into two cells. But each of the new cells must have a nucleus and centrosphere; and we know that these can only arise from already existing ones, and by division. The process of nuclear division, as before remarked, is usually a very elaborate one, commonly known to students of the cell by the name *karyokinesis*. Indeed, so fundamentally important does this process appear, that the simpler method sometimes observed is believed by many biologists to have a pathological significance. The first sign of approaching karyokinetic division in a nucleus is the thickening of the threads of the nuclear network. This thickening continues, and at the same time the power of the threads to take up certain staining substances, now much used in their study, rapidly increases. Gradually the network resolves itself into a loose skein or coil, and at last this breaks up into a number, varying much in different species, but pretty constant in the same one, of separate rods or loops. These individualized portions of the original nuclear network have received the name of *chromosomes*, from their marked capacity for staining. Meanwhile the centrosphere, if previously single, has divided, and one of the pair has moved to each of the poles of the nucleus. At least in the higher plants, this division has occurred long before.

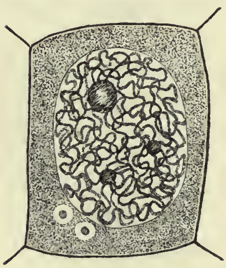


Fig. 1.

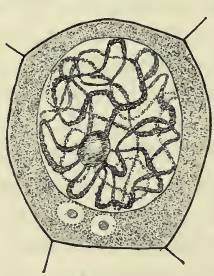


Fig. 2.

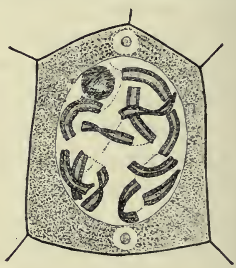


Fig. 3.

Fig. 1.—A plant cell, with its nucleus showing the chromatic network and nucleoli, and with a pair of centrospheres.
Fig. 2.—A plant cell whose nucleus is preparing for division.
Fig. 3.—A plant cell in an early stage of division, its twelve chromosomes separated.

The nuclear membrane now disappears and there is formed, perhaps from the homogeneous protoplasm of the centrospheres, or from the substance of the nucleoli, or from both, a spindle-shaped framework of delicate fibers, about whose equator the chromosomes become arranged in a circle. Then is completed a process which may have begun much earlier, and each chromosome is split longitudinally into two. Of each pair of daughter chromo-

somes thus formed, one now passes toward one pole of the spindle and one toward the other. In the higher plants, each polar centrosphere divides into a pair at about the time of the splitting of the chromosomes. Thus finally there are accumulated at each pole as many daughter chromosomes as there were mother chromosomes formed in the mother nucleus. Each of the latter has furnished one of the former, as will be seen, to each group. The

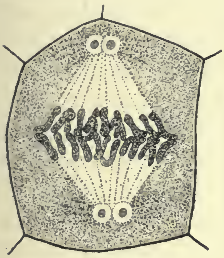


Fig. 4.

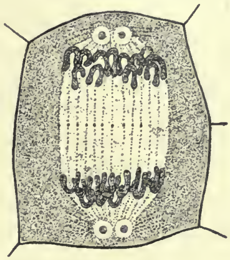


Fig. 5.

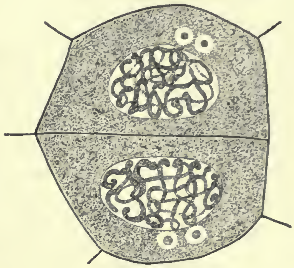


Fig. 6.

Fig. 4.—A plant cell in division, showing the nuclear spindle and the splitting of the chromosomes.

Fig. 5.—A plant cell in a late stage of division, the daughter chromosomes collecting at the poles of the spindle and the new cell wall beginning to appear.

Fig. 6.—Two daughter cells with nuclei which have nearly reached the resting stage, and each with a pair of centrosomes, the result of division of a mother cell like Fig. 1.

chromosomes of each group now fuse by their ends into a thread, and this gradually thins out until, by an inverse process to that observed at the beginning of division, it passes into the condition of a nuclear network. Meantime new nuclear membranes have been formed and two daughter nuclei with accompanying centrospheres replace the original one. Just what the mechanics of karyokinesis is has not been determined with certainty; and students of the cell are not yet agreed whether the centrospheres exert an attractive influence on the chromosomes, or are mere passive points of attachment for the fibers of the spindle.

There remains one constituent of the nucleus whose fate during nuclear division has not been discussed. This is the substance which forms the nucleoli. These bodies usually disappear slowly while the chromosomes are becoming individualized, and very commonly have quite disappeared before the disappearance of the nuclear membrane. Nothing more is then seen of them until after the constitution of the daughter nuclei and the formation of their membranes. Then nucleoli reappear within these nuclei. To what parts of the cell their substance is distributed while they are unrecognizable, and what purpose they serve in the cell economy, we do not yet know; but they are probably composed of a reserve substance which furnishes material for some formative process, perhaps for the spindle fibers, as Strasburger now thinks.

After the daughter nuclei are formed, the inclosing protoplasm divides between them, and thus there result two cells from the original one. In plants, their separation is commonly brought about by the formation of a distinct cellulose wall connecting with the original walls of the mother cell, and dividing the original compartment into two, and in most plants this wall begins to appear in the form of thickenings on the spindle fibers.

As we glance over this process of karyokinetic division just described, the phenomenon which must strike us as most significant is the longitudinal splitting of the chromosomes and the distribution of the resulting halves. Why should this exact halving of each chromosome and the invariable contribution of one half to each new nucleus be necessary? If it were merely important to divide the substance of a nucleus about equally between the nuclei derived from it, no such painfully exact method would be necessary; and, if unnecessary, we can not believe it would have been developed. Yet it is common to animals and plants of the most varying complexity of structure, and therefore doubtless of profound significance. Let us reflect that the cells of a given plant or animal possess and perpetuate the characters of that species. In case of many organisms, all or most of their cells are capable, under certain conditions, of reproducing the species to which they belong. And a given cell is always true to its kind. In other words, any cell possesses the hereditary characters of its species, which it has received from its mother cell and which it transmits to its descendants to the last generation. Two cells from two different organisms are, therefore, though indistinguishable in appearance, really as different as the organisms from which they were taken. The transmission of hereditary characters from cell to cell must, then, be definitely provided for. A little consideration will show that the evidence points at present distinctly to the nucleus as the probable seat of those characters in the cell. And, of the different constituents of the nucleus, no other has so distinct an individuality, or is so carefully divided between the daughter nuclei, as the substance of the chromosomes; while the evident need of a complete equipment of each nucleus with all the qualities of the species is quite met in its receiving an exact half of each chromosome. It is by no means proved, and it is perhaps not possible absolutely to prove, that the chromosomes are the material bearers of the hereditary characters of the species; but this view furnishes the best working hypothesis yet suggested as to the significance of the phenomena of karyokinosis. And it certainly correlates the concrete fact with the abstract problem in a most suggestive way.

In conclusion, it may be well to glance at some cell phenomena connected with reproduction. Allusion has already been made,

incidentally, to vegetative or non-sexual reproduction, which presents no further features of interest, since it differs from ordinary growth only in that the product of this form of growth does not usually remain attached to, and form a part of, the parent individual. On the contrary, it becomes separated, in most cases, from the parent, and sets out as a new individual. But in sexual reproduction we meet with a new complication. The phenomenon of sexual union, which occurs, at least occasionally, in an enormous majority of known organisms, and in very many must always precede reproduction, is essentially a fusion of two cells. And, since the male cell often consists of little more than a nucleus, it may perhaps be reduced, in its final expression, to a fusion of two nuclei. Now it is observed that the number of chromosomes in a dividing nucleus of a given species of plant or animal is approximately constant, and in the sexual nuclei quite so. After a male sexual nucleus containing, for example, twelve chromosomes has united with a female nucleus containing the same number, the fertilization nucleus thus produced proceeds to divide, and is seen to contain twenty-four chromosomes, or as many as were brought to it by both parent nuclei. And this number is found to persist without great variation in the nuclei of the new organism developed from the fertilized cell by successive divisions. It is plain that if the sexual elements produced from organisms of this generation contained twenty-four chromosomes each, those of their sexually produced offspring would have forty-eight each, and the point would soon be reached by successive doublings at which the capacity of the nucleus would be far overtaxed by the number of chromosomes. But this difficulty is avoided, in the plants and animals thus far investigated, by an abrupt reduction to one half the number usual in the organism, of the chromosomes of the nuclei of certain cells which are to give rise to the sexual cells. This reduced number remains constant in all the descendants of the nuclei in which it first appears, until the definitive sexual cells are formed. Then the fusion of two nuclei, each with the half number of chromosomes, restores to the resulting organism the typical number. This reduction has been spoken of as abrupt; and it could not well be more so. A nucleus in which it occurs receives from its mother nucleus, let us say, twenty-four chromosomes which fuse together to form its nuclear network. When, after a period of rest, this nucleus proceeds to divide, it develops from its network but twelve chromosomes, and therefore furnishes but twelve to each of its daughter nuclei. What has become of the other twelve no one can say, because nothing is known of the exact relations that exist between the individual chromosome of the dividing nucleus and any part of the network of the resting stage.

It is probable that this remarkable process of reduction has some far-reaching significance with reference to the origin and meaning of sexuality. Already theories concerning it have been suggested; but we are yet on the threshold of knowledge of the facts on which profitable theories must be based, and, until we have penetrated further within the portal, we can afford to suppress our propensity for speculation.

THE VIVISECTION QUESTION.

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I.—INTRODUCTORY.

FOR about thirty years the vivisection question has been before the public in this country. Discussion has often been hot and bitter, both in the press and in society, and again it is upon us in exactly its old form. What are we to do with it? What, so far as this country is concerned, has the controversy accomplished? After careful reading of all the important literature upon both sides, it appears to me that nothing has been gained either way. Both sides are practically where they were thirty years ago, and the failure seems to be due to fundamental misunderstandings of the real points at issue. In several hundred antivivisection publications I am unable to find a passage which reveals the least conception on the part of their writers of the real purpose which a physiologist has in his work. On the other side, while definite arguments have been advanced, no generous effort has been made to give the public a clear notion of what the physiologist in the study of health and the pathologist in the study of disease are driving at. Can something be said which shall do this? Or must physiologists work on under the distrust and suspicion of society because their aims and purposes are misunderstood?

The real question at issue, moreover, has been buried under personalities and under matters of detail, themselves involved in bitterest possible medical controversy, and the merits of which no amount of discussion, but time and experiment alone, can determine. Only by freeing the argument entirely from these things, and by placing it upon higher grounds, can we hope for intelligent peace upon this contested field. What, then, is the purpose of biological science?

Man finds himself in company upon the earth with an infinite number of living things, and he has found it of inestimable value to learn something about this maze of life. The science which

has come to embody this knowledge is now known as biology. It falls naturally into two great divisions: the study of the form and structure of organs and organisms—anatomy or morphology—and the study of the functions, of the actions, which the organs perform. This is physiology. Dividing further, physiology falls into the sciences of healthy action, physiology proper, and diseased action, pathology, from πάθος, a suffering. It is evident that for the study of form alone the dead body is in general sufficient. But for the investigation of the *activities* of health and disease it is as evident that the physiologist and pathologist require vital action as much as the chemist requires chemical action or the physicist requires motion. It is continually being urged that the dead body is sufficient for every scientific purpose. As well say that the dead body is as good as a live man. It would be precisely as reasonable to agitate against driving live horses, contending that dead ones will go just as fast, as to oppose the use of live animals for physiological or pathological research. And those who make this claim prove conclusively that they have no conception of what the word physiology means.

Of all physical Nature nothing is of greater importance or touches man more closely than just this thing, life. The study of form, anatomy, is little more than a dead stepping-stone to this science of the processes of life, physiology. Young as it is, no science has attained results of greater value and none gives brighter promise for the future. In a word, the faith, hope, and charity which inspire this science are to learn enough about the laws and possibilities of living Nature, to do away with all disease and premature death, and to make all life as full and perfect as these laws will permit. This is the inspiration of biology. Is it base or unworthy? And it is not Utopian. It is possible. The end may not be attained for a hundred years or a thousand. That depends upon how much faith men have in it and upon how much effort they are willing to devote to it. But it will come as surely as the world moves.

Take for a moment a broad view of our situation in this respect. Nearly one half of our people are dying before the age of forty-one, almost all of disease, curable or preventable, did we but know how. This goes on with our standing army of physicians, over one hundred thousand strong, on duty day and night. It looks discouraging, and an eminent physician has himself said that a doctor is like a man blindfolded, striking about with a club, almost as likely to hit his patient as the disease. Our only hope, therefore, must lie in more knowledge of the laws which govern living Nature. Without this, as well attempt to stay the storm and tides of the ocean with straw as the currents of disease and the course of Nature with doctors. If we could get before un-

prejudiced, thoughtful people some idea of the magnitude and scope of medicine and its importance to human and to all animal life, together with some faint conception of the moral forces impelling to the pursuit of those sciences which underlie medicine, in the light of these ideas the vivisection question would wholly disappear.

More than two hundred and fifty years ago, in the town of Schaffhausen, a German anatomist was engaged in studying the anatomy of the human body. The people loathed him as one possessed of the devil. They told him, in the words of an old superstition, that the stain of human blood he could never wash from his hands. His reply was, "I can wash the blood stains from my hands with a basin of water, but the stain of ignorance of anatomy can not be washed from the medical profession with all the water of the Rhine and the ocean."* Wepfer spoke of anatomy. Anatomy must precede physiology and pathology, as the structure must precede the function it is to perform. Thus Anatomy must prepare the way for physiology, and to some extent she has fulfilled her mission. But were a Wepfer to arise now, he would say, "The stain of ignorance of physiology can not be washed away with all the water of five oceans." I doubt, however, whether a modern Wepfer would lay the burden of blame at the door of the medical profession. It is everyday talk that physicians must lower their practice to the ignorance and prejudice of their patients. The idea of "magic" cures is still too deeply rooted in the average mind, and a doctor must "dose" a large proportion of his patients to satisfy this craving. At no time in the history of medicine has there been such a craze for patent medicines as now, and in no country is the situation so bad as in our own. We are the laughingstock of all Europe in this regard. In Germany apothecaries are prosecuted for advertising and selling American patent medicines. What hope, then, is there for rational medicine in a country that spends yearly hundreds of millions for worthless or harmful "patent medicines" and quack doctors, and but a very few paltry thousands for the advancement of physiology—and worse still, among a people who are as completely and just as intelligently satisfied with quack nostrums as men were in the dark ages with amulets and signatures, the moss scraped from a human skull, the powder of dried toads, or the hair of a saint?† In a nation of popular rule, the only hope seems to lie in scientific education of the people. How this is to be attained is a most difficult problem. The people will not educate themselves. Against such

* Rudolf Virchow. Archiv für pathologische Anatomie und Physiologie, vol. clxxxv, p. 375, Berlin, 1881.

† George F. Fort. History of Medical Economy during the Middle Ages, London, 1883.

education are naturally trained all the resources of quackery, whose trade would be gone. And where free expression is accorded to all alike, progress must be made in the teeth of ignorance too dense to have any conception of its own depth, and in the face of brawling charlatanry and screaming fanaticism. With nearly half our people dying before or about the prime of life, this is the situation. To teach ideas of cause and effect with reference to matters of health and disease, to inspire at least a willingness to heartily co-operate in efforts to control the causes of disease, our public-school system seems well adapted. But even here there is a serious tendency to hamper and restrict the proper teaching of physiology.

II.—VIVISECTION FROM THE STANDPOINT OF RELIGION AND MORALITY.

If vivisection is impious, immoral, or demoralizing, it must be abandoned as a method of research, and further discussion on grounds of utility is precluded. Hence this aspect of the subject must receive our first attention. Scarcely a paper appears against the practice of vivisection which does not contain solemn appeals to the Deity. These are too sincere to be ignored. In fact, the most active supporter of the agitation in England would confine the discussion wholly to these grounds, and invites us to "leave, then, utility alone, and all the weary controversy which hangs upon it." With the help of God, it (the national conscience) will yet abolish vivisection.* A recent expression of the American Society is as follows:

Resolved, That we, the American Antivivisection Society, believe vivisection to be morally wrong; to be distinctly opposed to the intent of a beneficent Creator, who wills the happiness of all his creatures; that we should, as Christians, unite in every effort for its suppression, and, as the best weapon of the Christian is prayer, *Resolved,*† etc.

The argument has been cast by Cardinal Manning into the following syllogism: Truth of Nature must be sought only by methods in harmony with the perfection of Nature's God. Mercy is one of the perfections of God. Vivisection is not in harmony with perfect mercy.‡ Therefore truth must not be sought by vivisection. How the worthy cardinal knows that vivisection is not in harmony with God's perfect mercy he nowhere explains. This is the all-important question. If this proposition is true, vivisection is impious, and must be abandoned immediately, no matter what its value to science, or utility to mankind.

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* Miss F. P. Cobbe. A Charity and a Controversy, London, 1889, p. 4.

† American Antivivisection Society Report, 1892, p. 19.

‡ Manning. Annual Address, Victoria Street Society, March 29, 1887.

Clearly the only way to find an answer to this question is to go to Nature itself and examine the principles upon which God has deemed it wise to order the living population of the world.

Doing this, we find living upon the world at present at least 272,090 different species of animals, the number of individuals in each species being beyond computation or expression. We also know that 39,925 species, with their countless numbers of individuals, have succumbed in the struggle for life and become extinct.*

Now, it has been ordained, in the perfect mercy of God, that each individual of this innumerable population be born, live for a little time, and die. With many species, birth itself is painful. With all, life is a continuous struggle and terminates in what is commonly called "the agony of death." Few, at least of the higher animals, struggle out the full measure of their days and die in peace. The vast majority are starved to death, or famished and scorched to death by heat and drought, buried in the burning *débris* of volcanoes or in snows and frozen to death, or are beaten to death by hail or drowned in floods. And in and through all this is the desperate struggle to find a grain of food, a drop of water, a little shelter, a foothold in the flood, a way out of the fiery hail or burning forest.

But harsh as is the relation between animal life and the physical world, still more severe are the relations of animals to one another. Here we see the weaker preyed on by the stronger mercilessly, and behold the array of vivisectional instruments—the teeth and jaws, the beaks and talons, the claws and fangs, developed for this purpose. Here the animals that escape the accidents of the physical world perish most miserably, are lacerated, torn limb from limb, are slowly crushed in serpents' coils or slowly swallowed alive. And again in all this is the last, probably of many, flight for dear life, the last convulsive effort to tear loose from the teeth or talons. Certain plants, even, are carnivorous, and entrap and digest living animals. More than all this, among certain animals, the males fight to the death for possession of the females of the species.

Still more terrible, many animals and plants become parasitic, and suck from day to day the life-blood of their hosts. Undoubtedly the greatest distress to which the animal kingdom is subjected occurs under this head. Some of the many diseases producing microbes become established in the animal. The dis-

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* Leunis. Synopsis der Thierkunde, vol. ii, p. 1176, Hanover, 1886. The above is merely the number of species known to Leunis in 1886, and by no means the entire number inhabiting the earth. Lord Walsingham estimates that there are upward of two million species of insects alone. (Entomological News, April, 1890, p. 58.)

ease ensues—slow, loathsome decay, sharp, convulsive torture, or the burning to death of fever.

All this is going on in the sea and on the land and has been going on for geological ages upon a scale which baffles expression in number or quantity. And this is God's ordering of Nature in "perfect mercy." With it man has had nothing to do, since there is every reason to believe that it existed ages before he appeared upon the scene. Cardinal Manning goes on to tell us that he believes in Genesis; but there we are told, "And God saw everything that he had made: and behold, it was very good." According to any estimate of the enormity of physical suffering which I have been able to find among antivivisection writers, the God who ordained such a scheme of Nature must be a monster of cruelty. What is wrong with the equation? The Creator? Nature? Or the ideas of antivivisectionists? Is it not true that the religion of a hermit's hut, a lady's parlor, or a pope's palace is apt to fit ill the problems of the wide world, and that we must go to Nature to study even religion?

This travail of the animal creation is the "Slough of Despond" for every philosophy but one. The biologist would agree with the Creator in pronouncing it "very good." He too has gained in some degree the divine point of view, and can see that out of the struggle comes the quickening to nobler form and higher life, and that, without this, life of any sort is scarce worth the living.

Few who drive thoroughbreds ever pause to think of the fleeing for life, through geological epochs, the kicking and biting, the hardship and training it has cost to give to the horse his beauty and strength, since the time when the fox-sized *Eohippus* picked his way among Eocene bogs. So with man, so with every form of life that has attained any height of development. The price has been great, but the gain is priceless; and we would not give back, if we could, all the suffering the world has felt and revert to vegetation and formless slimes.

Examining a step further, is it not possible to imagine a more merciful dispensation of Nature? Suppose all the "cruel" carnivora should be exterminated or become vegetarian. Would we not then have the animal millennium of certain sentimental people? No, far from it. The ensuing year would be the most dreadful in the experience of the animal kingdom upon the earth, and would end in death by starvation and disease of many more animals than are now annually appropriated by the carnivora. But suppose all manner of disease should be done away with—the millennium of scientific medicine; the struggle for food would be only the more terrible, and it is more merciful to kill in a night, even by pestilence, than in a month by starvation and the kicks and butts of stronger animals.

There is what is known as the "balance of natural forces." It is this that keeps the planets balanced in their orbits, and among animals it holds the species within the bounds which make for the greatest happiness of the greatest number. It is the plan of an all-merciful Creator, and man has never been able to suggest an improvement upon it, within the limits of physical conditions.

From the above, we see that every animal life is cast into the world *as an experiment,* often of the severest and most painful type. In this lifelong vivisection, Nature provides no ether or chloroform, nor even chloral or morphine.

By this very dispensation of Nature God clearly gives to man every sanction to cause any amount of physical pain which he may find expedient to unravel his laws. Not only this, the situation places upon man heavy duties, which he is bound to perform. These we will consider in a moment. As far as biological science is concerned the whole argument may be summed up as follows: Biology is not an exact science like mathematics and physics. These sciences are exact simply because it is possible in them to obtain as many equations as there are unknown quantities to be determined. Hence, with the solution of all possible equations, every unknown quantity in these sciences may be exactly determined. In biological sciences the case is thus far quite different. Here the unknown quantities are legion in every equation. Hence the extreme difficulty of any solid advance; hence the many mistakes, the many disagreements. In the best of experiments it is only possible to mass one series of unknown quantities against another series of unknown quantities so that they balance as nearly as possible, and then with our one unknown quantity, about which the experiment turns, make the best temporary solution of our problem possible. Thus the science must be content to proceed until the vast series of unknown conditions which influence life have been dealt with one by one. Thus, if the science is to advance, if we are ever to learn under what conditions life is most favorably placed, we must vary the conditions in every possible way—i. e., *experiment physiologically;* and, as we have seen, everything in the divine ordering of Nature is in complete harmony with this method, and bids man Godspeed in this great work.

Thus far we have considered Nature as uninfluenced by the presence of man. Let man, a moral being, take his place among the animal creation, and at once there spring up moral relations between him and every living thing capable of feeling pleasure and pain. It becomes his duty to do all in his power to increase the happiness and to diminish the suffering of every sentient thing. But we do not sympathize with the Hindu who lay down before the starving tigress in order to save her life and the life of

her whelps with his own. Man's first duty is to those of his own species. If wild beasts endanger the life of his wife or child, it becomes his duty to kill them by any means in his power, let the suffering be what it must. This is man's first step in the conquest of any country. And when he has rid the earth of the fierce carnivora, it becomes his duty to kill such numbers of the herbivora as will enable the rest to obtain food and enjoy life. This surplus man has always utilized for food and clothing. All this, however, is but his first step. He must tend herds and till the soil to support as many as possible of his own species. Even then his work is but just begun. If disease threaten the life of his child, is his duty any different? Certainly not. It is as much his duty to exterminate the disease as to destroy the wild beast. To subdue the earth, "and have dominion over . . . every living thing that moveth upon the earth," was one of God's first and highest commands to man; and it includes microbes as well as lions and tigers.

At just this point we are met with the argument that there is no moral proportion between the amount of suffering caused by vivisection and the advantage gained. "Suppose it is capable of proof," says Lord Coleridge,* "that by putting to death with hideous torment three thousand horses you could find out the real nature of some feverish symptom, I should say, without the least hesitation, that it would be unlawful to torture the horses." Accepting the proportion as stated, we will have: Torture of three thousand horses is to knowledge of real nature of feverish symptom as power gained by such knowledge is to prevention of death annually from splenic fever, we will say, of many millions of cattle, horses, and sheep, and thousands of men in Europe. There is no very exact "proportion" between end and means, but Nature is too generous to insist on exact "proportions" when men study her laws aright.

The difficulty with good people who reason out this "proportion" is that they fail to grasp the stupendous size of the problems involved, the whole world over and through all time. France alone is estimated to lose sheep to the value of four million dollars annually from splenic fever, and in one district, Beauce, one hundred and eighty-seven thousand sheep are killed annually by it. In Russia, during 1857, it was reported that one hundred thousand horses perished from the disease. In other epidemics, the losses within small districts reach tens of thousands, and in one a thousand people caught the disease and perished.†

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* Coleridge. The Nineteenth Century Defenders of Vivisection, p. 8.

† R. M. Smith. Therapeutic Gazette, November, 1884; and George Fleming. Vivisection and Diseases of Animals. Nineteenth Century, 1882, p. 470.

Or suppose it to be a "knowledge of the real nature of some symptom" of one of the fevers that are yearly causing in this country the premature death of nearly fifty thousand people,* and the knowledge gained saved the life of but one, the proportion would still stand approved in the minds of all humane people. I am aware that Miss Cobbe has said in effect, Our days are numbered, and I would not have my own or those of my friends spared or lengthened by the suffering of animals. This sentiment is sanctioned by no code of Christian ethics. For all normal, rational, and truly humane people the following statement of Prof. Davis is true beyond danger of cavil. He says: "When the brute's ordinary right to welfare, yielding exemption from inflicted pain, confronts man's right to welfare, it (the welfare of the brute) shrinks to zero and disappears." †

In order to test the popular acceptance of this principle, I actually put the following question to twenty American women: "Let the suffering be any amount necessary, how many dogs and cats do you feel that you would give to save the life of one human being?" Without exception, these women have answered, "*I would give all the dogs and cats in the world.*"

Contrast with this the following sentiments from the pen of a woman who is perhaps the most active agitatrix of antivivisection in this country. She answers as follows: "How many human lives which you 'experimenters' are so anxious (apparently) to prolong are really worth the time and trouble? . . . Would the world not be benefited were they allowed to pass to another sphere, where perhaps the conditions would be more favorable to moral and spiritual advancement?" Such perversion of human sentiment is little, if any, short of the pathological, and calls for no further comment.

Thus is seen the impossibility of separating morality from utility. If the right of the animal stand in the way of human use, "it shrinks to zero." If one human life can be saved, any amount of animal suffering necessary is justified. With this noble sentiment we thus accept the burden of proving that the sacrifice of animal life has brought us knowledge by which the human life has been prolonged and the sufferings of humanity have been ameliorated. With this proved, it is clear that it may be as much the moral and religious duty of a man to vivisect, who has faith that he can advance the cause of humanity by so doing, as it is his duty to preach or teach who has equal faith in these occupations. We shall treat the argument for utility in

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* Compendium of the Tenth Annual Census, pp. 1708, 1709.

† Prof. Noah K. Davis. The Moral Aspects of Vivisection. North American Review, 1885, p. 217.

the succeeding chapter. Before passing on to this head, however, two moral questions, fundamental to the whole discussion, must be carefully considered.

An assumption found in every, or almost every, antivivisection argument is that vivisection must be demoralizing to those who practice or witness it. Neither fact nor proof is adduced. From beginning to end it is pure tissue of antivivisection imagination, like the old assumptions against the first anatomists. The assumption is not only unfounded but thoroughly irrational. It would be precisely as sane to assume that a missionary who goes to preach among the heathen tends to become heathenous; or that anything in the practice of surgery or medicine tends to blunt the sensibilities of men in these professions. Granting that there are brutal men in the medical profession, as there are in all others, carries no proof that their work has made them so. It may have made them decidedly more humane than they ever would have been without it.

On just this point I have taken the pains to collect the testimony of experienced teachers of physiology in thirteen institutions in this country, where the greater part of our vivisectional work is done. In every case the moral effect of experimentation is claimed to be wholesome, and in no case have they any evidence of its being evil. I will quote from but one instance, the experience of a professor in an institution for the higher education of women. He writes: "In numerous cases students have entered the course with decided objections to the practice of vivisection; and in no case, so far as I know, have they left without the removal of their objections and the substitution for them of sound views as to the necessity and value of vivisectional work."

The other question is one which touches the bed rock of human life: What is the use of living anyway? It is Franklin's old question, "What is the use of a baby, unless it is to become a man?" but with the added question, What is the use of the man? A good many people every year look their lives in the face in this way, and, deciding that this life is of no use or worse than no use, put an end to it.

Furthermore, What is, or what may be, the value of a man's life work? And how far have we the moral right to pass judgment as to the value or use of another's life or work? With the earth reeking in carnage and with humanity and animate Nature writhing in pain, how is it possible to say that God has ordered Nature wisely and mercifully? And taking Nature as we find it, what can man do about it?

One theory has always been that the forces of Nature and life are far too vast for man's feeble powers to influence for good or

for ill; that his chief duty lies in resignation to fate. Directly opposed to this is the spirit of modern science, which considers it man's duty to go to work and manufacture fate. What right, it would ask, have we to assume that the forces of Nature are difficult of control until all the laws which govern them are investigated? Numberless instances in the history of science prove that his powerlessness is a mere bugbear of man's own imagining. It may be so in all cases. If man will only put forth a reasonable amount of effort, it may not be so difficult to comply with the command, "Subdue the earth."

Still, the old superstitions cling tenaciously to the best of men. A child sickens and dies, and we say, "It is the will of God, so let it be." What right has man to lay this flattering unction to his lazy soul? The scientific spirit would say: "It is the ignorance of man. It is his duty to learn enough about this disease to prevent or cure it." In taking this position science simply accepts the universal principle that ignorance of law does not exempt from penalty, and hence would study the law under which the calamity occurred and, by obedience, escape the penalty in future.

To conclude in a sentence the result of a chain of reasoning too long to even outline in detail, all the suffering and physical evil in living Nature finds ample justification for its existence if, serving as a spur to man, it arouses him to use his intelligence and put forth every energy available to alleviate the misery of the world and improve its condition. In other words, Nature is *wisely* ordered to give *man plenty to do*, and to do this work is one of his highest duties. How he is to accomplish it, depends upon the means he finds at hand, which prove themselves useful to his purposes.

In passing to a consideration of the utility of scientific experimentation, it must be remembered that we are not discussing the question with infanticides, murderers, or would-be suicides. It can be considered only with those who believe that, after moral excellence, human life and happiness and freedom from disease are the most useful things in the world.

A SPELÆOLOGICAL society has been formed in France, at the instance of M. E. Martel, for the study of everything relating to caves, including artificial ones. At the end of December, 1895, it had one hundred and seventy-five members. It publishes a quarterly bulletin, *Spelunca*, and Memoirs, of which three numbers have been issued. It has endowment members, who contribute not less than four hundred francs; titular members, who pay fifteen francs a year; life members, who make a single contribution of two hundred francs, and corresponding members, who pay five francs a year. The general secretary is M. Martel, rue Ménars 8, Paris.

IMMIGRATION AND CRIME.

BY SYDNEY G. FISHER.

THE criminal influence of the alien with its steady increase can be traced back in our history for the last sixty years. So surely and yet so gradually has it grown upon us that we have now become thoroughly accustomed to a condition of things which would have been extremely shocking to our rugged ancestors as they are sometimes called.

When our system of foreign immigration first began to reach serious proportions, about the year 1820, its effect on our manners and morals soon attracted attention. The Native American party, which arose soon after 1840, based its strongest argument on the enormous increase of crime which followed the advent of the foreigners. The belief and confidence in the cheap labor of the immigrant were very strong in those days, or the people would never have been willing to go on with the system in the face of the shocking revelations of pauperism, crime, and corruption which became more and more apparent from 1830 to 1850.

The newspapers and pamphlets of that time published statistics which showed that, although the foreign population was only an eighth of the whole, yet it furnished two thousand more paupers and a thousand more criminals than all the remaining seven eighths of the people. Every thirty-two foreigners produced a pauper, and every one hundred and fifty-four of them produced a criminal; but it required three hundred and seventeen natives to furnish one pauper and sixteen hundred and nineteen to furnish a criminal.

The census of 1880 attempted to summarize the relative proportions of the foreign population which were paupers and criminals as far back as 1850. The statistics on which the calculation was based were somewhat incomplete, but so far as they go they show the same result that all other similar investigations have shown. The foreigner in proportion to his numbers furnishes by far the greater part of pauperism and crime.

Ratio to 1,000,000 of Population.

	1880.	1870.	1860.	1850.
Paupers:				
Native	994	1,635	1,849	1,765
Foreign	3,438	4,095	7,843	5,986
Prisoners:				
Native	1,054	733	371	207
Foreign	1,917	1,568	2,161	1,074

The Massachusetts census of 1885, which was taken with great care and completeness, shows the same condition of affairs. The foreign born of that State were 27·1 per cent of the whole population, and yet they furnished 44·03 per cent of the paupers, 40·60 of the prisoners, and 36·87 per cent of the convicts.

If we take the statistics of the children of foreigners the result is almost the same. The people of foreign parentage in Massachusetts are 47·36 per cent of the whole, yet the number of prisoners with both parents foreign born was 60·30 per cent, and the number of convicts with both parents foreign born was 51·14 per cent.

The statistics of the national census of 1890 reveal the same condition. The native white element of the population is 54·87 per cent, but it produces only 43·19 per cent of the white prisoners. The foreign white element, counting foreign born and the children of foreign born, is only 32·93 per cent of the population, and yet it produces 56·81 per cent of the white prisoners.

The statistics may also be stated by ratios per million in each class so as to include the negroes, which gives a still more striking result:

Prisoners.	Ratio per 1,000,000.
Native white	882
Foreign white	1,747
Negro	3,250

The negro, though born on the soil, is in every sense an alien, and if we wish to see how much crime is due to our various experiments in importing foreign populations we have only to connect the negro ratio of crime with the foreign white ratio and compare them with the native ratio. The result can be seen by a glance at the above table and is rather startling.

We hear a great deal about the crime of murder in the United States and its great increase, and it may be interesting to know the source of a large portion of it. Our population is now divided into native white, foreign white, negro, Chinese, Japanese, and civilized Indians; and the census of 1890 shows the percentage of homicide to be assigned to each in proportion to percentage of population:

Population.	Percentage of population.	Percentage of homicides.
Native white	73·24	44·00
Foreign-born white	14·56	16·40
Negroes	11·92	37·11
Chinese and Japanese	0·17	1·28
Civilized Indians	0·11	1·21

The natives, it will be observed, though almost three fourths of the population, commit less than half the homicides; while the aliens, including in that term the negroes as well as the foreign born, though only about one fourth of the population, commit more than half the homicides.

How many of the murders committed by natives are due to the example and presence of the foreigners can not be estimated, but it is doubtless no small proportion.

The number of murders committed by the black race is very large. Out of the 7,386 prisoners indicted for homicide, 4,425 were white and 2,739 were negroes. In point of numbers the negro population is less than a seventh of the white population, and yet the negroes commit more than half as many murders as the whites.

In counting up the cost of the foreigner, in addition to what he kills, burns, and destroys, it may be well to mention the charge we are put to in maintaining his paupers, a service which we have now performed for him for many years with great generosity in our almshouses. Census Bulletin No. 90 has it in a nutshell: "The foreign population of this country contributes, directly or indirectly, in the persons of the foreign born or of their immediate descendants, very nearly three fifths of all the paupers supported in almshouses." In other words, although the foreign element is much less than half of the whole population, it nevertheless furnishes more than half of the paupers. If we leave out the pauper descendants of foreigners and count merely the foreign-born paupers, we find that they alone outnumber the native paupers.

The original native population of the United States, which fought the Revolution and built up the country for the next fifty years, was remarkably free from the habit of settling every petty dispute by homicide, and yet a large part of them were people who may be said to have passed their lives with firearms in their hands. They were hunters and Indian fighters, and they were all familiar with war, whether against the French, the Indians, or their own race in the Revolution; but in their personal disputes among themselves they seldom attempted to kill. The frontiersman of that period usually settled quarrels with his fists. In the Whisky Rebellion of 1794, which was long continued and serious enough to have an army sent to suppress it, the rioters did not take a single human life. They tarred and feathered some of their enemies, shaved their heads, and indulged in other rough treatment. Even after two or three of their number had been shot by the authorities they showed none of that anxious desire for killing that now characterizes rioters.

When the dispute between Connecticut and Pennsylvania for

the possession of the Wyoming Valley had been settled by a legal decision soon after the Revolution, the Pennsylvania Legislature passed an act in 1787 organizing the valley as a part of Pennsylvania. A meeting of the Connecticut settlers in the valley was called to decide whether they should accept the act. There were two parties among them, one in favor of the act, the other against it, and in the heated discussion of the meeting they came to blows. After the first blow was struck each party rushed, not for their guns, but for sticks, which they cut from the neighboring trees, and for a time there was a very savage contest; but not a single shot was fired nor was there a single blow given with a knife, and after a while they came together again and passed a resolution accepting the act. Yet they were all frontiersmen, accustomed to the almost daily use of rifles and hunting knives.

About the time of the Revolution there were riots in Boston, New York, and Philadelphia, and much property was destroyed; but in only one, the riot in Philadelphia over the depreciation of the Continental currency, were lives taken. The same characteristics prevailed in Shays's Rebellion in Massachusetts.

The first riots in which an intense desire to use firearms and kill was shown were the Catholic riots of 1844, which were begun by foreigners firing into a meeting of native Americans. From this we have gone steadily on, until we now have more rioting, bloodshed, and murder in a single year, or even in six months, than can be found in a hundred years of our previous history, and in almost every instance it can be traced to the alien element in our population.

Washington, in writing on the subject of immigration, said:

> My opinion with respect to emigration is that, except of useful mechanics and some particular descriptions of men or professions, there is no need of encouragement; while the policy or advantage of its taking place in a body (I mean the settling of them in a body) may be much questioned. (Works, xi, p. 2.)

On another occasion he wrote:

> It is not the policy of this country to employ aliens where it can well be avoided, either in the civil or military walks of life. (Works, xi, pp. 392, 393.)

Jefferson, though belonging to the party opposed to Washington, had very much the same opinion:

> They will bring with them the principles of the government they leave, imbibed in their early youth, or, if able to throw them off, it will be in exchange for an unbounded licentiousness, passing, as is usual, from one extreme to another. It would be a miracle were they to stop precisely at the point of temperate liberty. These principles, with their language, they will transmit to their children. In proportion to their numbers they will

share with us the legislation. They will infuse into it their spirit, warp and bias its direction, and render it a heterogeneous, incoherent, distracted mass. I may appeal to experience during the present contest for a verification of these conjectures. But if they be not certain in event are they not possible, are they not probable? Is it not safer to wait with patience twenty-seven years and three months longer for the attainment of any degree of population desired or expected? May not our Government be more homogeneous, more peaceable, more durable? Suppose twenty millions of republican Americans thrown all of a sudden into France, what would be the condition of that kingdom? If it would be more turbulent, less happy, less strong, we may believe that the addition of half a million of foreigners to our present numbers would produce a similar effect here. If they come of themselves they are entitled to all the rights of citizenship, but I doubt the expediency of inviting them by extraordinary encouragements. I mean not that these doubts should be extended to the importation of useful artificers. The policy of that measure depends on very different considerations. (Works, viii, p. 330.)

The prophesy in the above passage has most certainly come true; and the last two sentences are also worth considering. "I mean not," he says, "that these doubts should be extended to the importation of useful artificers. The policy of that measure depends on very different considerations." This will at once be recognized as agreeing exactly with Washington's words where he says, "that except of useful mechanics and some particular descriptions of men or professions there is no need of encouragement." Washington, though strongly opposed to the admission of foreign officers in the army, had made exceptions in the case of certain artillerists and engineers, who he said were needed to teach us some of the fine points of gunnery and construction, and in his objection to immigration in general he made exceptions in favor of certain kinds of skilled labor.

In short, these Fathers of the Republic were entirely opposed to promiscuous, wholesale immigration, and they undoubtedly represented the opinions of a large number of our people at that time. The importation of paupers, vagrants, and criminals, together with hundreds of thousands of men and women capable only of cheap manual labor, was altogether foreign to their thoughts, or, if they contemplated it at all, it was only to revolt from it. Even Madison, who favored immigration more than any of the other fathers of the republic, and who introduced in Congress the first bill intended to encourage it, always insisted that he intended to bring over only the "worthy part of mankind," and in a letter written in 1813 he expresses almost the same opinion as Washington and Jefferson:

I am obliged at the same time to say, as you will doubtless learn from others, that it is not either the provision of our laws or the practice of the Government to give any encouragement to emigrants unless it be in cases

where they may bring with them some special addition to our stock of arts or articles of culture. (Works, ii, p. 576.)

Neither Madison nor any of the others had any conception of modern immigration, and apparently never realized that their moderate and, as they supposed, well-regulated encouragement would bring it about.

ILLUSIONS AND HALLUCINATIONS.

By Prof. WILLIAM ROMAINE NEWBOLD.

I HAVE already had occasion more than once to speak of the development of a mental state from the stage which we term *idea* to that which we term *sensation*. Before taking up the matter in hand it will be necessary to go into this question at somewhat greater length.

We seldom have difficulty in discriminating an idea from a sensation, but it is not easy to define the difference between them. This is partly due to the fact that the differences are very complex, and partly to the fact that they vary in the respective fields of sensation, so that one can scarcely frame a definition for ideas and sensations of vision that will also prove applicable to those of sound, touch, and so on. Ideas of sound differ from the corresponding sensations chiefly in intensity, but in the case of vision a much more important distinction is drawn from the relation sustained by visual ideas to what the eye actually sees. At the present moment I am thinking of something I saw yesterday, but what I see with my eyes is not in the least affected by that. The two groups remain distinct, and it would seem as if an almost impassable gulf parted them, so seldom does a bit of one become confused with the other. This is not true of ideas of sound. If they only become intense enough they may seem to blend with real sounds—indeed, I often mistake an air of which I am thinking for the same air faintly heard.

The distinction between sense-impression and idea really rests upon intrinsic differences of this kind, but as they are so complex I shall make use of a physiological distinction which for all practical purposes coincides with it. Sense-impressions are those mental states which are primarily initiated by a current from the outlying regions or periphery of the body, especially from the organs of sense. Since these currents are usually due to the action of physical forces upon the body, sense-impressions generally give us information as to the condition of the material world. All other mental states should be classed as ideas, even though they simulate sensations so closely as to be scarcely distinguishable from them.

From this point of view the peculiar characteristics of the impressions of sense are due to some peculiarities in the cortical processes which are their physical bases—peculiarities which are usually due to the action of a peripheral current. Thus it may be that the sensation is more intense because the current acts upon the stored-up energy of the cortical cells much as a spark acts upon gunpowder. If precisely the same kind of a cortical process could be induced in any other way than by the action of a peripheral current, we would presumably have an imitation sensation. There appears no good reason why there should not be many other kinds of cortical processes intermediate between those that underlie ideas and those that underlie sense-impressions, and to them mental states should correspond which are betwixt and between—neither fish, flesh, nor fowl.

Now, of the cortical processes we know nothing; I use them merely as symbols for mental facts. But the mental states we directly know, and it is quite certain that many different types of them exist, roughly corresponding to what we would expect if the above conception were true. We know that in different individuals ideas vary much in their clearness and in the degree to which they approach sensations. In the same individual they occasionally assume a form which is to him almost like a glimpse into a new world of experience. My own visual ideas, for example, are very vague and dim, and I shall never forget the two or three occasions in my life when they have for a while been vivid and brightly colored, somewhat as my visual sensations are. And occasionally we meet with experiences which are certainly originated largely or entirely from within and must be classed as ideas and yet resemble sensations so closely that they can be discriminated from them only upon reflection. These are what we term illusions and hallucinations; the other types, which we never mistake for realities, although they resemble sensations so closely, are termed pseudo-hallucinations. By the level or grade of a mental state I mean the degree to which it approximates that fullest and most perfect form of being which we find in the sense-impression, and by development I mean the process of becoming more like the sense-impression.

What can cause development? Well, in the first place, it can be caused in some individuals by concentration of attention. Most of my readers have heard the story of the painter who said he could at any time see again a sitter by looking at the chair in which he had once sat. I have met many such persons. Sometimes the process is slow and its several stages can be traced. Miss Z——, for example, after fixing her thoughts upon the image of a friend, sees a shadow appear before her which gradually assumes color, consistence, solidity, reality, and finally becomes the

living image of the friend. But with the least distraction it vanishes like a soap bubble. In other cases the process is instantaneously completed. Rev. Mr. F—— can at any time by an act of will create an image of a friend, and after doing so finds it hard to lay the ghost which he has himself raised. Images voluntarily externalized nearly always seem subject to curious limitations. Often it is possible to externalize persons only, or only certain persons, or only in definite attitudes. The apparition rarely appears possessed of independent life, it seldom moves spontaneously, and its features reflect no play of thought; it also often disappears upon being touched. All these are common traits of ghosts, and the identity goes to show their common origin.

In the second place, the development of an idea is sometimes clearly traceable to a simultaneous but disconnected sensory stimulus. A striking illustration of this fact fell within my own experience not long ago. I had had a fatiguing and anxious day, and consequently could not sleep. As I lay in bed, dim, silhouette-like forms began to outline themselves in the darkness, as sometimes, although very rarely, happens when I am tired and excited. I was trying to make one out, when I heard a crackling sound. Instantly the shadowy image was illumined by a brilliant flash of white light, and I saw two dumb-bells lying crossed with the balls toward me. For a moment my impression was that some one had brought a light into the room, although my eyes were closed; but upon opening them I found that my brother had entered without a light through a Japanese screen made of slender wooden rods strung lengthwise. The crackling sound made by the parted screen had raised my thought-image to sensory intensity. Parish gives another good illustration.* A physician, while experimenting in this line, thought of a section of liver and tried to see it, at the same time pressing on the ball of the eye. "At first he was clearly conscious that his mental image was quite dim and confused; yet suddenly an image of a section of liver stood before his eyes as if seen through a microscope, clearly outlined, and with all its arteries, veins, and gall ducts beautifully colored in red, blue, and greenish violet."

In the third place, the degree of vividness which a mental state attains seems to bear an inverse relation to the number of ideas which it suggests. I can not go into the proof of this statement here, as it would lead me too far astray into the field of normal psychology, but those who care to follow it out will find it set forth by Prof. James in his Psychology, volume ii, page 124. It is also true that hallucinations are common in states in which

* Ueber die Trugwahrnehmung, p. 134.

there seems to be an arrest of the processes of association. Such are, for example, all hypnotic states. The analogy to the forms of transmission of physical energy is striking, and has led Prof. James to conjecture that the higher development of the few ideas remaining is in some way a compensation for the arrest of association. "If," he says, "we regard association paths as paths of drainage, then the shutting off of one after another of them as the cerebral paralysis advances ought to act like the plugging of a hole in the bottom of a pail, and make the activity more intense in those systems of cells which retain any activity at all." Prof. James then quotes from Taine a vivid description of the rise in the level of the idea trains as the association paths are closed by sleep. "All external sensations are gradually effaced, or cease at any rate to be remarked; the internal images, on the other hand, feeble and rapid during the state of complete wakefulness, become intense, distinct, colored, steady, and lasting: there is a sort of ecstasy, accompanied by a sense of expansion and comfort. Architecture, landscapes, moving figures, pass slowly by, and sometimes remain with incomparable clearness of form and fullness of being; sleep comes on, and I know no more of the real world I am in. Many times, like M. Maury, I have caused myself to be gently roused at different moments of this state, and have thus been able to mark its characters. The intense image which seems an external object is but a more forcible continuation of the feeble image which an instant before I recognized as internal; some scrap of a forest, some house, some person which I vaguely imagined on closing my eyes has in a minute become present to me with full bodily details, so as to change into a complete hallucination. Then, waking up on a hand touching me, I feel the figure decay, lose color, and evaporate; what had appeared a substance is reduced to a shadow. In such a case I have often seen, for a passing moment, the image *grow pale*, waste away, and evaporate; sometimes on opening the eyes a fragment of landscape or the skirt of a dress appears still to float over the fire-irons or the black hearth."

In the three types which I have been discussing, the mental state was present as a thought before being externalized as a hallucination, and for many reasons hallucinations of this type are the most instructive. But very often the hallucination is not only not a mere externalization of a thought already present, but has no apparent connection with anything of which the patient is at the time thinking. Hence the theory of development needs to be supplemented by other considerations, and one may draw them from either of two quite different, although I think not inconsistent, points of view. In the first place, one may suppose that the hallucination is sometimes initiated from without, through some

derangement in the mechanism of perception, and has nothing to do with what the patient is thinking of. In the second, one may have recourse to the theory of subconscious states and assume that every hallucination had a true mental existence, if not conscious, then subconscious, before being brought to the upper consciousness. The first is the old orthodox theory of illusion, and, to make it intelligible, I must say a little of the normal processes of perception.

Our sense-impressions are primarily initiated, as I have said, by currents from the periphery of the body, but their final complexion is only in part determined by the peripheral currents; it owes much to the condition in which the cortex happens to be and to the manner in which it is constituted. We may roughly compare it to a penny-in-the-slot machine. Without the penny there would be no response, but the precise character of the response is determined by the constitution of the machine. The case of the brain is similar, but infinitely more complex. Most of our sense organs send in very complex currents: from the eye, for instance, we get currents which, taken alone, would cause sensations of color, touch, and movement—the slightest change in the number and relative adjustment of these currents, even though it be so slight that we can not possibly be aware of it as a change in the simpler sensations, will totally change the character of the sense-impression. These sensory currents are like the keys and stops of an organ, and any one who knows just what stops and keys to manipulate can get any response he pleases. Thus the technical part of painting consists in so imitating the ordinary sensory determinants of vision by means of colors on a flat surface as to produce that cortical process which is usually produced by a real thing.

It is not often possible to trace the operation of these factors in our sense-impressions. Each seems an indivisible mental whole. But sometimes we can distinguish them. In the first and third of the three types of hallucination which I have already analyzed, the character of the hallucination is clearly determined by the first or central factor, and its development also seems to be due to some central factor or factors. In the second of the three the character is determined as before by the central factor, while its development to sensory intensity is due to its accidental coincidence with the arrival of a sensory current, which is a peripheral factor. These are all termed hallucinations centrally initiated, or true hallucinations. In the types which I shall now take up the character is always chiefly determined by peripheral currents, and, presumably, they are also responsible for the sensory intensity of the image. These hallucinations are termed peripherally initiated, or simply illusions.

The following account may be taken as typical of the true illusion:*

"One evening, at dusk, I went into my bedroom to fetch something I wanted off the mantelpiece. A street lamp threw a slanting ray of light in at the window, just sufficient to enable me to discern the dim outline of the chief articles of furniture in the room. I was cautiously feeling for what I wanted when, partially turning round, I perceived at a short distance behind me the figure of a little old lady, sitting very sedately with her hands folded in her lap, holding a white pocket handkerchief. I was much startled, for I had not before perceived any one in the room, and called out 'Who's that?' but received no answer, and, turning quite round to face my visitor, she immediately vanished from sight. 'Well,' I thought, 'this is strange!' I had left all the rest of the household downstairs; it was hardly possible that any one could have followed me into the room without my being aware of it, and besides, the old lady was different from any one I had ever seen. Being very near-sighted, I began to think my eyes had played me a trick; so I resumed my search in as nearly as possible the same position as before, and having succeeded, was turning to come away, when lo! and behold! there sat the little old lady as distinct as ever, with her funny little cap, dark dress, and hands folded demurely over her white handkerchief. This time I turned round quickly and marched up to the apparition, which vanished as suddenly as before. And now being convinced that no one was playing me any trick, I determined to find out, if possible, the why and because of the mystery. Slowly resuming my former position by the fireplace, and again perceiving the figure, I moved my head slightly from side to side, and found that it did the same. I then went slowly backward, keeping my head still until I reached the place, when, deliberately turning round, the mystery was solved. A small polished mahogany stand near the window, which I used as a cupboard for various trifles, made the body of the figure, a piece of paper hanging from the partly opened door serving as the handkerchief; a vase on the top made the head and headdress, and the slanting light falling upon it and the white curtain of the window completed the illusion. I destroyed and remade the figure several times and was surprised to find how distinct it appeared when the exact relative positions were maintained."

In this case the form of the illusion seems to have been almost entirely determined by sensory stimuli, but in many cases the operation of the central factor can still be traced. For example, Parish quotes † from Prof. Lazarus an experience of his own.

* Proceedings of the Society for Psychical Research, vol. x, p. 95. † *Op. cit.*, p. 135.

Prof. Lazarus had been wearying his eyes trying to make out a certain rock on a distant mountain side; as he turned away he saw vividly the corpse of a friend stretched out before him. Upon reflection he found that this friend had been associated with the train of ideas that had filled his mind just before he began to look for the rock. He also found that whenever he closed his eyes he saw a dull, grayish-green, corpselike color, which was the complementary after image of the dull reds, browns, and greens of the mountain side. He also found that other persons of whom he thought appeared to him of the same corpselike tint. In this case the main character of the hallucination—that is, the thought of a friend—was furnished by association of ideas, but its special form, the appearance of that friend as a corpse, as well as its sensory vividness, seems to have been due to the peripheral factor.

A closely analogous experience is reported by a Mrs. L—— in the Proceedings of the Society for Psychical Research, volume x, page 143: "About September, 1881, aged forty-six, and eighteen months after the sudden death of my mother, which had shaken my nerves very much, one night toward morning, being awake to the best of my belief, I saw a woman come through the door. Her face was sideways and I distinctly saw her features. She passed slowly from the door and went out at the window opposite, thus passing across the foot of my bed. She had on an old-fashioned bonnet and an old-fashioned caped coat, and she was carrying a basket in front of her such as country women carry their husbands' dinners in. The whole figure was semi-opaque, neutral-tinted, like thick smoke or cloud. A great hurricane was blowing. I was dreadfully disturbed and hysterical next day—the impression so vivid and yet unable to say who it was. About a week after, the revelation came. I sat down to dinner, became very hysterical and faint, and went into another room alone in the dark. All at once I jumped up, saying, 'It is Mrs. Beasant!' Mrs. Beasant was the pretty young bride of a farmer with whom, when about ten years old, we used to go and take tea at a farm about two or three miles from the vicarage. One day she went with her husband's dinner as usual, and he was felling a tree. She passed the wrong way, and the tree fell on her and killed her. I remember watching her funeral with my nurse, and the anguish of spirit at her death, but never remember speaking of it or the circumstance since. The day before the appearance a nurse of the name of Beasant had disturbed and annoyed me. A few months before a large elm tree had fallen in our garden and partly on the house. A hurricane was blowing at the time, and I remember thinking, 'What a lucky thing that tree can't fall on the roof!'" Clearly the storm, the falling tree, and the annoying nurse were

the chief factors in determining the character of the hallucination, but as they acted through association it is not so clear to what its externalization is to be ascribed. Perhaps the hurlyburly of the storm outside had something to do with it; probably the drowsy, disordinated condition of the percipient favored the formation of the apparition, but of the details of the process one can not speak with confidence.

In the hallucinations of which the crystal vision is the type we have a form intermediate between the true hallucination and the illusion. Prolonged staring into a mirror, a glass of water, a crystal, a piece of glass, or even fixation of the gaze upon a point will induce in some persons brilliantly colored hallucinations. While they are certainly peripherally initiated by the prolonged staring, their special character is nearly always centrally determined—usually, indeed, they simply reproduce old memories. Susceptibility to these hallucinations is by no means uncommon; I have tried about a hundred persons myself, and found that about one in four saw something. Similar hallucinations of hearing can be produced by listening to the "sound of waves" in a large shell, to the sound of water running from a spigot, etc. The stories of ghosts seen in mirrors probably all rest upon this principle. For example: *

"The first hallucination which I was in a position clearly to recognize as such occurred during the Indian mutiny. Several members of our family were in danger. One night on which we had all been talking late of them, after we had parted and gone upstairs to bed, I stood before my dressing table, plaiting my hair, when my attention was arrested by a faint spot in the center of the mirror; this, to my amazement, gradually enlarged (as a grease spot spreads with heat) till the whole surface was covered, and then, in the center of this veil, came through the face of one of the near relatives above mentioned, as plain as might have been his living reflection. I noted the day and hour, and ascertained, six weeks later, that the relative seen had incurred no sort of danger at that date." This misty discoloration of the glass is significant, for many of my subjects describe the glass as becoming milky or cloudy just before the hallucination appears. Occasionally it is possible by means of an indeterminate stimulus of this sort to raise a thought to sensory intensity. Thus Miss X—— saw in the polished surface of a piano a scene of which she was thinking.† I have met with one analogous experience, but it seems to be rare.

Many interesting questions arise as to the relation that exists

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* Proceedings of the Society for Psychical Research, vol. x, p. 407.

† Ibid., vol. v, p. 512.

between the hallucination and the stimulus which has generated it. It is frequently very close, any change in the stimulus either destroying the hallucination or making in it a corresponding change. In the case of crystal gazing, for example, if one looks at the image through a magnifying glass or prism, it is sometimes destroyed and sometimes magnified or doubled. Very often hallucinations originated independently appear to attach themselves in much the same way to some contiguous percept and become practically a part of it. The element to which it is attached is what the French investigators have termed the *point de repère*, and M. Binet has endeavored to show that without such a *point de repère* no hallucination can exist. The matter is still under discussion, and must be set aside with this brief allusion.

If we once admit that subconscious states exist, we are tempted in many cases of hallucination to make use of the conception to explain the facts. In the case of Mrs. Beasant's ghost, for example, it may be that the memory was revived before the apparition was seen, but remained subconscious until externalized by some obscure agencies which one can not precisely specify. An analogous experience—in this case a crystal vision—is given by Miss X——: *

"I find in my notebook a memorandum of August 3d as to a vision of a corner of a room, with a red carpet and walls decorated in stripes of pink, white, and green, for which for many months I was unable to account. Only a few days ago (May 10, 1889, is the date of writing) I called on a friend whom I had not visited since July, and whose house had, I observed, been newly and handsomely decorated. A letter which she had written to me before leaving town in the summer was by chance referred to, and on returning home I sought it, to settle a disputed point, and found that it was dated August 2d and contained the information that her staircase had been painted and 'looked at present like a Neapolitan ice.' This, I doubt not, supplied the coloring of my picture."

Here the development of the vision was influenced by an allusion contained in a letter read the preceding day which was no longer in mind. Now, one must suppose either that that allusion still existed in some way and was capable of influencing the vision, or that the vision had been suggested subconsciously, had existed subconsciously, and had been brought to light by the crystal, or that it had been suggested by the letter, forgotten, and then revived. Of these three suppositions the last is the most plausible, but it is difficult in other cases to resort to it. Take another case of Miss X——'s: "On March 9th I saw in the crystal

* Proceedings of the Society for Psychical Research, vol. v, p. 512.

a rocky coast, a rough sea, an expanse of sand in the foreground. As I watched, the picture was nearly effaced by that of a mouse, so large that I could see only a bit of cliff above his tail. Two days later I was reading a volume of poetry which I remembered having cut open, talking the while, certainly not consciously reading, on the day of my vision. As I turned over the leaves, a couple of lines struck me as somehow familiar, though the book, a volume by Aldrich, was quite new to me:

> Only the sea intoning,
> Only the wainscot mouse.

These, I imagine, suggested the images." Doubtless Miss X——'s eye had fallen on these lines; possibly they aroused some fleeting images in the upper consciousness which were then forgotten. But granting the existence of the subconscious, it is more easy to understand the case upon the supposition that the whole process took place outside the range of her normal consciousness.

A still more striking case of the same author's has been much quoted:

"On March 20th I happened to want the date of Ptolemy Philadelphus, which I could not recall, though feeling sure I knew it, and that I associated it with an event of some importance. When looking in the crystal some hours later, I found a picture of an old man with long, white hair and beard, dressed like a Lyceum Shylock, and busy writing in a large book with tarnished, massive clasps. I wondered much who he was and what he could possibly be doing, and thought it a good opportunity of carrying out a suggestion which had been made to me of examining objects in the crystal with a magnifying glass. The glass revealed to me that my old gentleman was writing in Greek, though the lines faded away as I looked, all but the characters he had last traced—the Latin numerals LXX. Then it flashed into my mind that he was one of the Jewish elders at work on the Septuagint, and that its date, 277 B. C., would serve equally well for Ptolemy Philadelphus. It may be worth while to add, though the fact was not in my conscious memory at the moment, that I had once learned a chronology on a mnemonic system which substituted letters for figures, and that the *memoria technica* for this date was, 'Now Jewish elders indite a Greek copy.'"

If this strange vision had ever been suggested to Miss X—— before by her mnemonic line, why did she not recognize it? And if it had not been suggested before, either it had been suggested in her subconsciousness or else it was suggested to her upper consciousness by a subconscious memory of the mnemonic line.

Another of Miss X——'s visions * is almost precisely similar to that of the sea and the mouse, save that it is still more difficult to suppose that she had any conscious knowledge of that which was revived in the crystal: "It was suggested to me, one day last September, that I should look into the crystal with the intention of seeing *words*, which had at that time formed no part of my experience. I was immediately rewarded by the sight of what was obviously a newspaper announcement in the type familiar to all who read the first column of the Times. It reported the death of a lady, at one time a very frequent visitor in my circle and very intimate with some of my nearest friends, an announcement, therefore, which, had I consciously seen it, would have interested me considerably. I related my vision at breakfast, quoting name, date, place, and an allusion to 'a long period of suffering' borne by the deceased lady, and added that I was sure that I had not heard any report of her illness, or even, for some months, any mention of her likely to suggest such an hallucination. I was, however, aware that I had the day before taken up the first sheet of the Times, but was interrupted before I had consciously read any announcement of death. Mrs. Henry Sidgwick, with whom I was staying, immediately sought for the paper, where we discovered the paragraph almost exactly as I had seen it." If Miss X—— had consciously seen this notice, how came she to forget it?

Cases of this kind strongly suggest, I think, what Mr. Gurney calls "an underground psychosis," but they do not demonstrate its existence; and, unfortunately, most of the cases which would seem to require the assumption of subconscious states also require the still more revolutionary assumption of such powers as telepathy and clairvoyance, which lie outside my present scheme of topics.

All these forms of hallucination are known as sensory automatism, and in my last paper I sketched the conception which underlies the term. I there also alluded to ideal automatism, and with a few words upon that point I must let the subject go.

Our thought trains usually belong to well-defined types, are of a certain average grade of development, and behave in pretty definite ways. For example, they are for the most part subservient to our will, and come and go at our bidding. But sometimes the orderly process of thought is broken up; new classes of ideas obtrude themselves, familiar types rise to a higher level without becoming full-fledged hallucinations, and, last but not least, the will finds itself unable to control them. Such disorders of ideation are often termed ideal automatism. As a very large

* *Op. cit.*, p. 508.

part of our thinking is carried on in ideas of spoken words, a very common form of ideal automatism is the inner voice. A portion of the patient's word ideas rise to a higher level than usual, resist his will, and often say things which strike him as strange and foreign to his own acknowledged thoughts. For the sake of completeness I must refer to this type of automatism, although space forbids me to discuss it in detail.

SOCIAL INSECTS.

By L. N. BADENOCH.

IT is well known that some bees are social and form nests where their broods are reared, workers existing who provide daily for the young. In architectural skill these social kinds do not always hold a foremost place. The cells composing their nests vary in shape from the perfectly hexagonal, as in the hive, to those which are less regularly six-sided, until in the bumblebees' homes they are not in the least like the delicate, sharply defined structures of the true honeybee, but are oval and isolated or distributed almost at random.

Leaving the hive bee out of the question, the bumbles (*Bombi*) alone construct social communities in England; they constitute the nearest ally, as regards its habits, of the true honeybee in North America, which is especially rich in species. Their economy is simple; their colonies begin, enlarge, and end like wasps. They live for one season, perishing with the cold of autumn, except a few queens, which hide themselves away in utter solitude in sheltered and convenient spots, and, awaking with the warmth of spring, lay the foundation of a new swarm. In the ordinary course of things these queens do not survive a second winter.

Parasitic bees (*Apathus*) so closely resemble the bumbles that it requires long practice to distinguish them easily. Little is known of the parasite, other than that it is found in the nests of its hosts, at whose expense it apparently lives, after the manner of the cuckoo. It has no pollen basket, showing that it can not collect food, and its young must feed upon the stores of their hosts, and its jaws seem unadapted for building. Flies and several beetles also prey upon the bees, and the larvæ of moths consume their honey and waxen cells.

In the tropics the honeybee is replaced by the *Meliponæ* and *Trigonæ*, which are generally minute and almost stingless, and live in vast colonies. The former construct a comb for their young, resembling that of the hive, but of one layer of cells, while the honey cells are irregular and occasionally attain a great

size. They nest in hollow trees or in banks or any suitable crevice; the *Trigonæ* suspend pear-shaped combs from the extremities of the branches of trees, without any kind of external covering. *Meliponæ* are masons and prone to block up the gap in the tree they employ with clay, leaving a small orifice for entrance and exit; some stop theirs with wax, and they incline to feed on the sweet sap that exudes from the forest trees and on the excrement of birds rather than on flowers.

Fig. 1.—Nest of Polistes. A wasp's nest without cover.

As with the communities of social bees, so with the social wasps (*Vespidæ*), there appears a third order of beings, the workers or neuters, which, like the females, are provided with a sting. The interest attached to the economy of the family rivals that of the wonderful works of the hive; indeed, many of the structures of the social wasps constitute the most beautiful examples of insect architecture. Among them there is a variety of form, an evidence of intelligent choice of the materials used in their construction, a difference of texture produced, and an adaptation of the nest to the circumstances of the situation to which the buildings of the bee can lay no claim. If the hive bee is the more admirable architect, it is decidedly not the most ingenious. It is the better mathematician, but the less facile engineer; it is the more learned, but the less imaginative. While the bees may be said to build in wax, the social wasps are chiefly natural paper or cardboard makers—not out of rags, but ligneous materials, triturated and agglutinated in various ways. Though the nests are upon many plans, essentially they are all alike. Similar cells, nearly always hexagonal, are agglomerated, leaving between them no space to form combs, after the manner of bees, but of very varying aspects. These are the cradles of the larvæ, which, deposited here as eggs, are reared by the female or workers, and,

having attained full growth, they inclose themselves within the cups, with silky convex caps, until their transformation to perfect wasps.

So far as the disposition of the social wasp is concerned, it is a case of being given a bad name, and—well, maltreated. But a wasp seldom attacks when unmolested; yet threaten its citadel, and you will probably have cause to repent, for, with courage that we all must admire, it boldly and persistently resents intrusion on its dwelling and defends against disturbance its helpless young brood.

It combines the most opposed instincts of diet, and is an omnivorous feeder. From the first days of spring till autumn ends, we may see wasps (*Vespa*) intent upon stealing the sweet vegetable liquor they love; in spring they profit by the blossoms of fruit trees. As the fair profusion of summer changes to the soberer autumn wealth, they are presented with another fertile source of nutriment, and it is then their colonies immensely increase. They fall upon fruits voraciously, the choicest and most ripe, and so have gained for themselves a worse reputation than insects much more injurious. Should the season be warm and the increase of their colonies commensurate with the warmth, as it often is, they become a veritable plague, not only in gardens, but at table they agitate us while they nibble at some luscious dish.

FIG. 2.—HOME OF MYRAPETRA SCUTELLARIS.

But, hateful marauder though the wasp is in these respects, it is a predaceous as well as a vegetable eater, and thus not devoid of the compensating quality of usefulness in ridding us of many a fly and other pests. The audacity with which it seizes and devours insects is astonishing. The attack is sudden: it will spy a fly on the leaf of a bush, and in the twinkling of an eye is upon it; if large, it is dismembered; head, wings, and legs are torn off, and the trunk is

demolished on the spot or borne away. Wasps often attack butterflies of different kinds; pouncing upon the luckless victims, as a falcon on a bird, they drag them to the ground and mutilate them, and subsequently the mangled body seems to be robbed of all vitality ere the wasp takes its final departure with it to the nest. Curiously, if it misses its aim, it does not strike a second time, but flies on, as if to cover its defeat. Immoderately fond of honey, it frequents the vicinity of beehives, ready to swoop on the bees returning home charged with their hard-got spoil.

Social wasps have two principal modes of nidification. Either the combs are enveloped in a covering of simple leaves of generally slender paper, analogous to that which serves for the cells; or the covering is of cardboard, composed of only one layer of material, of a consistence at times extraordinarily thick and resisting, at others slight and supple.

The common paper-makers build in the open air, on trees or bushes, under the roofs of outbuildings, on a beam, or in some such situation; the construction corresponds with that of the ground wasps, but the texture of the foliaceous envelope, which is fabricated with perfect art, has all the appearance of shell-work. It incloses an infinity of cells arranged in many tiers. A nest is invariably built from above downward. The start is made by accumulating on the determined site a good supply of paper, forming it into an umbrellalike canopy. To the under side of this cap—the ceiling, so to speak—the first comb is attached, and the rest of the work consists in prolonging the canopy more or less in an egg-shape, and in establishing additional combs, free, as a rule, only pendent to columns of paper, which pass from the upper surface of each comb to the comb immediately above; entrance is obtained at the lower end. Toward the summit of the envelope is a thickened cellular mass, but this portion excepted, it is made up of a number of separate leaves or layers of paper, limited in size and imbricated, and in contact together merely at the points of imbrication, leaving large cellular spaces between the sheets; moreover, the points of fusion of two successive sheets never fall one over the other. Each sheet therefore lies on a stratum of air, with the result that the exterior layers may be soaked with rain without soiling in the least the ones beneath. Tree wasps increase the size of the combs by cutting away the inner layers of the envelope, taking care to add layers externally so as to maintain, and even to slightly augment, the thickness of the walls, in proportion to the greater magnitude now assumed by the edifice.

Some elegant and graceful pensile nests, although diverse in form, have this in common, that the combs are always destitute of any envelope; and the cell-group is supported by a stalk of paper,

which may be central or wholly lateral. Usually a varnish is rubbed on the cells to prevent them being wetted by rain (Fig. 1).

The envelope of a typical cardboard-maker (*Chartergus chartarius*) is of a veritable cardboard, white, gray, yellow, or buff in color, smooth and solid, and impervious to the weather. It may be conical, cylindrical, almost globe-shaped, straight, but more often is a little curved. In the interior the platforms of cells differ from those of the common paper-making wasp in stretching right across like so many floors, being fastened on all sides to the walls. A simple hole perforates each, enabling the wasps to get from story to story. The form arises from the mode of enlargement of the dwelling. When the number of inhabitants becomes great and a fresh series of cells is required, these wasps do not, as a preliminary proceeding, amplify the envelope so as to extend the tiers; they first build cells, and cover them afterward. Beginning with the bottom of the nest, they set cells upon it, then lengthen the outer wall so as to include this fresh stage, and close in the end with a new floor, in its turn to become the ceiling of the next tier of cells when enlargement is again desired. No trace of the addition is suffered to remain and mar the covering, which would seem constructed at one stroke. Probably these wasps, like *Myrapetra scutellaris* (see Fig. 2), deviate from the ordinary habits of wasps in being collectors of honey.

It would be difficult to find a more peculiar nest than that of *Myrapetra scutellaris*. It is huge as compared with the insects, its brown cardboard wonderfully thick, hard, firm, and coarse in texture, and composed, not of wood fibers, but of the dung of the *capincha*, an aquatic cavy. The strange, fairly conical knobs that beset the surface of the envelope may defend the abode, which hangs low, against mammalia, such as tigers, jaguars, and cougars, that would plunder it of its honey; they appear to protect and conceal the entrance ways—of which, opposed to the custom of wasps, there are many—but they may be simple freaks of Nature. It seems odd for beings so sensible to put these projections on the end of the nest, no less than on the sides, necessitating their gnawing them away each time they add a stage; but probably they possess some means of softening the cardboard, and doubtless the same material, worked up afresh, helps to establish the new tier and the new cells.

It is represented in a bulletin of the Department of Agriculture that about two hundred and fifty thousand cocoanut palm trees of all ages are growing on the eastern coast of Florida, about twenty-five thousand of which are bearing. The tree is fruitful near the salt water, but does not thrive when removed inland. It begins to fruit in from five to seven years after planting the nut.

THE POTTER'S ART AMONG NATIVE AMERICANS.

By ALICE D. LE PLONGEON.

Of all the arts at which man has labored, that of molding clay was probably the first, the most primitive. It has been practiced in all parts of the world, and the thousands of specimens yet existing are an aid to archæological studies, particularly when found intact and unblemished. It is never easy to decide on the age of any piece, as this is not necessarily indicated by its appearance, least of all in places where, as in Mexico and Peru, cunning artificers manufacture antiquities, making jars a few weeks old appear like the time-begrimed handiwork of their great—very great—grandfather or mother; for women have been and are active in that branch of industry. The Mandan women were clever potters. The Zuñi and the Maya women also do much of that work. A new-looking, well-preserved vase may be a rare antique, while a roughly finished primitive one may be modern or of comparatively recent date. There are scholars who claim that some of the Central American and Peruvian specimens are thousands of years old.

In several parts of America it was customary to place various receptacles in tombs, close by the human remains, some jars being usually filled with food and liquid. The pottery found on the Atlantic coast is poor and not abundant, but there is a great quantity in the western part of the United States, as well as in Mexico, Central America, and Peru. Colorado, Missouri, and Ohio are States which have yielded very large collections, varying from crude work to some that is admirable, a certain similarity existing in all. The Alaskan productions are considered of a better quality, in paste and in baking, than any other on the American continent. Some of the large Alaskan vases were coated with a grayish-white wash, and polished after the manner of Phœnician wares. They were decorated with bold devices in black and dark red.

The North Americans modeled their utensils by hand, without wheel, and none seem to have understood the art of glazing. They mixed their clay with pounded shells, with sand, or with pulverized siliceous rock; mica was also used. After being shaped, the clay was hardened in open fires or kilns. Among the many ornamentations, that imitating basket work was much used, and may have suggested itself because the modeling was sometimes done inside of baskets. Similar devices are common on ancient German pottery. The Greek ornament ( ) was very common in America, while Phœnician art is suggested by some of the life forms seen on the Peruvian and Chiriquian

pottery. In the Peruvian most of the care bestowed on the decorations was given to the faces of the creatures represented, the rest of the body being fashioned without any apparent attempt to faithfully imitate Nature. Some pieces found in ancient tombs resemble Etrurian or Etruscan work of the same class. The potters did their best work on jars that were to be deposited in sepulchres. Articles for domestic service were of the simplest description. The materials used for the funereal vessels, called *huacas* and *canopas*, were light-colored clay and a blackish sort of earth mixed and worked in such a way as not to absorb liquid. The secret of that method is lost to us. Some of the finest productions appear to have been submitted to the action of fire, but the majority have evidently been hardened only by the heat of the sun.

FIG. 1.

A long, slim neck is a distinguishing feature of much of the Peruvian pottery; and nearly every vessel is ornamented with a figure of some sort, having holes to represent eyes and other openings. These afford a passage for the air forced out by the liquid when poured into the vessel. By an ingenious contrivance the air in escaping produces a sound similar to the cry of the creature represented. Thus a utensil decorated with two monkeys embracing each other, on having water poured into or from it, would give a sound like the screeching of those animals. One decorated with a bird would emit birdlike notes; while a mountain cat on one jar would mew, snakes coiled around another would hiss. The most curious that we have seen was the figure of an aged woman. When the jar was in use her sobs became audible, and tears trickled down her cheeks. The manufacturers seemed to have known all about atmospheric pressure. Dr. Le Plongeon had in his own collection a piece that demonstrated this. It represented a double-headed bird. The vessel had to be filled through a hole in the bottom,

and yet in turning it over not a drop would spill, but the liquid would readily flow out when the jar was simply inclined. The Peruvians were good portraitists, and many of the faces represented might pass for likenesses of people now living on the coast. The potter of the present day uses a primitive contri-

FIG. 2.

vance, something like two tables fastened together and revolving on an axis firmly fixed in the ground. The lower table serves as a treadle by which the workman imparts a rotary motion with his naked feet to the whole contrivance. On the upper table, the smaller of the two, is placed the moist clay which the potter shapes to his fancy.

The pots found in tombs are made of various kinds of clay—red, yellow, brown, bluish, and black. The latter is generally only modeled, the red being modeled and painted. None are glazed. Many of the Peruvian jars are double, quadruple, sextuple, even octuple. The pottery of the Antis is believed to be of Quichua (Peruvian) origin. It is coarsely made, painted and varnished. From the cannibal Conibos they obtain, through the Chontaquiros, more elegant ware.

The illustrations (Figs. 1, 2, and 3) represent pieces found by Dr. Le Plongeon on the coast of Peru, all belonging to a period

prior to the Inca civilization; they are from six to ten inches high. The canopa, an upright bottle, in Fig. 3, is very suggestive, its name calling to mind the canopi, or funeral vases used by ancient Egyptians, though the word is of Maya origin, as Dr. Le Plongeon has fully explained in one of his books. Traveling south of Peru, we find that in Chile, near Santiago, the capital, there is a fragrant clay called *buccari*, of fine quality and light weight, its color being brown with yellow spots. The inmates of convents convert this into varions utensils which they paint, gild, and varnish. It is said that water placed in them has an agreeable perfume and flavor. North of Peru, in Ecuador, near Quito the capital, a similar clay is found.

Chiriqui is an interesting field for students of the ceramic art. Politically Chiriqui is a part of South America, while geographically it belongs to the northern continent. It is between Veragua on the east and Costa Rica on the west. Pottery is most abundant in the lands around the bay of David, though found all along that part of the coast. The Chiriquian modeling shows more symmetry of form than any other on the continent. In graves, from three to twenty pieces are usually found. One explorer obtained ten thousand articles of clay from burial places covering an area of fifty square miles. The ware is uniform. The matrix is of fine clay tempered with pulverized sand. Grains of quartz, feldspar, hornblende, iron oxide, etc., can be detected. Argillaceous matter was sparingly used except in outer coatings, the

Fig. 3.

sand in many instances comprising at least seventy-five per cent of the mass.

Some of the work is similar to that in Costa Rica and the Colombian States. The Maypures of Colombia form cylinders of clay, and shape even the largest vases by hand, without any wheel. In Nicaragua, too, clay utensils are formed entirely by

hand. After being baked some pieces were partially glazed, or varnished with a resinous gum, warmed over a bed of coals and gently rubbed over the vessels. The natives on the Amazon employed a similar method.

With clay the Chiriquians made a great variety of objects, including many shaped vessels, drums, whistles, rattles, stools, spindle whorls, needle cases, toys, and other small objects. The baking was effected with a low degree of temperature, and in a way that produced no discoloration. All the work was skillfully done and so neatly finished that the method by which it was accomplished can not be detected. The eye and the hand of the manipulator must have been exquisitely trained.

Complex pieces were made in parts that were cleverly put together, no portion being injured. The heads and other parts of animals, handles, legs, bases of vessels, were luted on with consummate skill, the thinnest walls and most complex delicate forms not being injured in the process. Before the surface wash was applied, the whole was carefully smoothed. After the application, and when the clay was somewhat indurated, smooth pebbles were used to polish the surface. This was sometimes done so thoroughly that the finish has been mistaken for glaze of a vitreous nature. Ornamental painting and intaglio devices were usually done after the polishing. The general colors of the paste were light yellow, gray, ochery yellow, and pale terra-cotta red. Dark brown, salmon, and orange hues are occasionally found. The paints used for decorating were reds, blacks, and purple grays. The red varied from a light vermilion to a deep maroon. The colors are indelible, and are believed to be of a mineral character.

Many jars were manufactured only to be placed with the dead. Tripods are supposed to have served for religious ceremonies as braziers. Most of the fine pieces were made expressly for religious or funeral purposes. The various forms were always symmetrical. Some jars had as many as four mouths.

Among the various ornamental devices are included fish, crabs, frogs, crocodiles, pumas, and monkeys, also a conventional serpent. Too much can not be said in praise of the beauty of outline of these vases, but in any case where the artist has attempted a human figure the result is a deplorable failure. There are a few double-headed vases and an approach to the modeling of jars in animal forms after the Peruvian style.

There are at least ten varieties of painted ware, apparently the work of different communities. Generally speaking, the vessels were not of large dimensions, some elaborately ornamented ones being only four inches high. Even cooking pots were what we should call decidedly small. It is evident that the Chiriquians

were lovers of music, judging by the instruments fashioned from clay. It is hardly likely that the musicians confined themselves to that material in their production of sweet sounds. Terra-cotta drums, rattles, whistles, and flutes have been found. There are rattles shaped like the gourd, which vegetable product seems to have first served man as a rattle. The Mayas of Central America yet use it in certain religious dances. The handles of Chiriquian rattles were made as whistles. The bodies of drums were sometimes made of clay, though these specimens are rare. They were shaped somewhat like an egg-cup, the small part serving as base, the tissue or skin being stretched over the larger orifice.

The wind instruments are capable of yielding very sweet though not powerful or far-reaching tones. The note on any one stop is in some instances susceptible of change by varying the force of the breath, affording much scope to a skillful performer. With

FIG. 4.

FIG. 5.

the exception of the drums the clay instruments are not more than about eight inches long. The whistles were constructed on the same principle as the modern flageolet. They give eight or more notes, though not a true scale. The bird was quite appropriately a favorite shape for whistles, the finger holes or stops being in the breast. On them a practiced performer could imitate the song birds with some accuracy.

In Corozal Island on the east coast of Yucatan, there are vases with flaring rims supported on three short legs, like some of Chiriqui. Our illustrations of Chiriqui pottery are: 4. Vase with four handles—decorations in black, red, and purple. Ten inches high. This form is frequently found in Mexico and Central America. 5. Vase, eight inches high, with hollow base. Elaborate designs in red, white, black, and purple. Equal to Chinese or Egyptian work. 6. A tripod nine inches high. Similar ones have been found in Cozumel Island, having hollow legs, contain-

ing pellets. Notwithstanding the beauty and symmetry of their work, the Chiriquians seem to have lacked one faculty that the people farther north, in Honduras and the Yucatan peninsula, had fully developed; for they failed to portray, even poorly, the human face, while the latter were clever portraitists.

Fig. 6.

In Honduras a wealth of pottery may be dug from the soil; but this must be done with care, otherwise the frail things will inevitably be broken, owing to their moist condition. When exposed to air and sunlight they become hardened and may be handled with less risk.

At Mugeres or Woman's Island (latitude 21° 18′ north and longitude 86° 42′ west, Greenwich meridian)—so called by the Spaniards because they found many statues of women there—an ancient shrine stands on a rocky promontory at the south end of the island. There the waves perpetually dash themselves as if in blind fury. Atom by atom the rocks must yield to the force of perpetual motion; then this old shrine of strong masonry will fall into the maw of Neptune. Long ago thousands of pilgrims used to bring to the spot votive offerings of all kinds. Fragments of pottery are scattered over the ground in front of the building. Delving in the sand, we brought to light a fine incense-burner. Unfortunately, a man, too anxious to help, thrust a spade in the sand and broke the object before we had time to say "Hold!"

Afterward, in one of the fragments, we kindled charcoal to varnish photographs which we had taken. From the heated pottery an exquisite odor was wafted on the air. Thus, once again, and probably for the last time, was the shrine perfumed with the sweet incense which had permeated the porous clay, and truly it was delicious enough to delight not only the most fastidious devotees but the most exacting divinities. The face which had ornamented the burner escaped injury, as did the feet from the lower part of the brazier. Able potters of these modern times have pronounced the face a very fine piece of modeling. It is now in the museum of the Antiquarian Society of Worcester, Mass. The woman represented did not belong to any of the races that followed the customs of deforming their skulls; but she had her front teeth filed in points, a fashion which was in vogue among some Americans as it is among the Fans of equatorial

Africa. This may indicate that the individual depicted on the burner was a Maya. The Mayas never deformed their skulls; and some of them filed their teeth in just this way, as can be seen in the statue called Chaacmol, unearthed by Dr. Le Plongeon. A duplicate of the statue is in the museum at Washington.

About forty miles south of Mugeres Island, and ten from the east coast of Yucatan, is the abiding place of Spring, the lovely island of Cozumel, almost uninhabited now. When the Spaniards arrived there, three hundred and sixty-five years ago, it had a hundred thousand inhabitants, besides an annual concourse of fifty thousand pilgrims that worshiped at its temples. This "place of swallows" (*cuzamil*, hence Cozumel) is an interesting spot for the antiquary. In the dense forests there are curious old buildings, and round about them, beneath the surface of the ground, may be found many a specimen of the ceramic art. Illustration No. 7 shows a fine incense-burner from there, with scarcely a blemish, and similar to the one so unfortunately broken at Mugeres Island. Its ornamentation represents the goddess of the bees. Like the other, this forehead shows no artificial deformity. The clay was of fine quality and in color a rich red brown, while the broken burner was of a light yellowish clay found only on the mainland. After examining hundreds of specimens we are inclined to believe that among those people individuals were given names suggested by some trait in their character or peculiarity of appearance, and that the artists ingeniously indicated such appellations in a headdress or other ornament. In some instances such headgear as this was used in battle.

Fig. 7.

Pottery from Palenque exhibits entirely different features. The two vases here given (Fig. 8) are in the Government House of Balize, British Honduras. Here we see the Palenque type, with artificially deformed forehead. The way in which the hair is curled and banged suggests a very rakish Bacchus, appropriate ornamentation for an antique punch bowl. The Honduranians seem to have been as ingenious as the Peruvians in their terra-cotta works. We have before us two jars which appear to be glazed in imitation of bronze. One is intended to represent an armadillo, the other a familiar domesticated hen that cackles melodiously when the water gushes from her open

beak. This effect is produced by a small pebble cleverly placed in her throat.

Among figures of all shapes and sizes several had holes that did not enhance their appearance and were not in accordance with Nature. A dog, for instance, may be allowed a mouth and two eyes, but why an extra pair of orbs on each side of its small body? Simply that the impertinent-looking pup was a musical instrument, the six eyes corresponding to six sweet and clear flutelike tones—C, D, E, F, G, A. On these clay instruments the native melodies can be played, their compass not exceeding six notes.

In the deep sand at Progreso, port of Yucatan, objects of clay have frequently been found. One in our possession is interesting because of what it represents. The double mouthpiece gives the notes C and D. Blue paint yet remains on the clay (blue was emblematic of sanctity), indicative of the veneration which was attributed to the creature, roughly suggested by the uplifted proboscis. The mastodon, whose visage is depicted everywhere on the walls of Yucatan's ancient cities, was taken by the Mayas as one symbol of the Creator. They made it their god of the ocean, life being first generated in water. Beneath the upturned proboscis there is a mutilated human face surrounded by a broad collar or necklace.

Fig. 8.

The persons who in ages gone by had used the little dog-flute and the double whistle just described were not unfamiliar with the seductive weed, for in applying our lips to them the flavor and odor of tobacco were quite unmistakable. The late General Bogran, when President of Honduras, personally found the clay pup and gave it to us, so that the tobacco was not imparted to it after its discovery.

In the National Museum of Mexico's capital are some ornamental vases, three feet high, which might perhaps justly be regarded as the culmination, the perfection of the ceramic art—they are so very handsome, fine and intricate in form and decoration. But to which of the Mexican tribes the work should be ascribed is a question. In the State of Oaxaca funeral urns have been found inscribed with Maya hieroglyphics which have been interpreted

by Dr. Le Plongeon. Their meaning is "the extinguished," "the snuffed out"; a brief but unquestionable allusion to the deceased.

There is a fascination about antique pottery. In handling a funeral vase, for instance, one can not help indulging in a little imagination about the scenes which occurred when the object was placed in the tomb. Visions of queer figures and fantastic rites flit before our mind's eye till we shake off the waking dreams, breathing a vain wish that the clay might be endowed with the power to tell, not its own story, but of those events which transpired in connection with it.

DUST AND SAND STORMS IN THE WEST.

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FOR some years the writer has been gathering data on the transportation of sand and dust by the atmosphere, with a view of studying the geological significance of these phenomena. Among other sources of information the newspapers have been drawn upon, and it is to the facts gathered from these, and by personal correspondence that it is at present desired to direct attention. The newspaper man may not always state facts with such exactness and precision as would be desirable, but his ubiquity no less than the very conservatism of the scientist, who seeks the broadest possible foundation for all generalizations, combine to give him a function in the investigation of the laws of Nature. Of course, it can be only a humble function—that of an observer who is not always to be trusted. For the lack of training or by reason of other shortcomings his accounts of natural phenomena must sometimes be taken *cum grano salis*. Dust storms occur chiefly over arid lands, and they develop their greatest force mostly only in regions which are but sparsely inhabited, if at all. They are not often witnessed by geologists. As a consequence, they have been but little studied, and it is desirable to collect information from all sources with regard to their nature and occurrence.

While dust storms are sometimes to be seen east of the Mississippi River, they are much more frequent in the arid and semi-arid regions of the western part of the United States, where the rainfall is small. Of the thirty-eight storms found recorded during 1894 and 1895, only one occurred east of the Mississippi. The distribution over the Western States and Territories was as follows:

California	9	Oklahoma	2
Arizona	7	South Dakota	2
Washington	5	Nevada	1
Oregon	3	Montana	1
Colorado	2	Nebraska	1
Kansas	2	Iowa	1
North Dakota	2	Illinois	1

While the number of reported storms is too small to warrant a discussion of their geographical distribution in the United States, the above table so far, no doubt, correctly represents the facts that it shows an increase from the Western plains to the Pacific coast, and comes to a maximum in the Southwest. On the plains most places are reported to experience dust storms two or three times in a year, while on the Pacific coast estimates and records for different places range considerably above this number. At Los Angeles, Cal., one observer says that there are "two or three in the course of a year, possibly a few more." From Yuma, Ariz., the statement comes that "any high wind, without rain, generally blows clouds of dust," and six sand storms were recorded by observer A. Ashenberger in the Weather Bureau station at that place during 1893. At Ontario, Cal., it is estimated that there are from twelve to forty dust storms in a year. It is said that these storms are "most common and strongest in passes in the mountain ranges in California," that they are "very severe on the east side of the Coast Range," and that "nearly every part of California is afflicted [by them] at times." From the reports which are at hand an estimate of the minimum frequency of these disturbances in places in the West, where topographical and climatal conditions do not forbid them, is two in a year for the territory east of the Rocky Mountains and five in a year for the Great Basin and the western slope. A maximum estimate would be four annually for the former region and twenty for the latter.

Data on the areal extent of each separate storm are meager, as reports of simultaneous observations have been secured in but few instances. Where such observations have been reported they represent, as is evident, the minimum extent of the storm in one direction, since it may have extended beyond the points from which the reports have come. The few instances of reported areal extent of dust storms may be tabulated as follows:

Areal Extent of Single Storms.

From Milton, Ore., to Colfax, Wash	80 miles.
" Fresno, Cal., to Santa Maria, Cal	120 "
" Mojave, Cal., to Oceanside, Cal	140 "
" Salem, S. Dak., to Sanborn, N. Dak	216 "
" Santa Anna, Cal., to San Diego, Cal	270 "
"Over the greater part of Nevada"	300 "
Over most of northern Iowa and Illinois	400 "

This gives an average diameter of two hundred and sixteen miles.

Information has also been sought with regard to the length of time that these storms continue to blow at any one place. In several instances the reports state this time, and in these cases it varies from one to forty-two hours, and averages a little over thirteen hours, as may be seen below:

Duration of Dust Storms.

2 storms lasted for	1 hour.
2 " " "	2 hours.
1 storm " "	4 "
2 storms " "	6 "
2 " " "	8 "
2 " " "	12 "
1 storm " "	16 "
1 " " "	18 "
2 storms " "	24 "
2 " " "	30 "
1 storm " "	42 "

Supplementing these direct observations, estimates have been obtained from a few parties, and these make the time considerably longer. These estimates are as follows: "Sometimes an hour, sometimes three days, coming with great violence at intervals." (One hour, seventy-two hours.)—"We have known one that continued a week, with one day for a recess."—"The sand storms last from one day to three days, but sometimes only a few hours." (Four hours, twenty-four hours, seventy-two hours.)—"The sand storms last about one day." (Twenty-four hours.)

Leaving out the storm that lasted six days, thirty-two hours would appear to be a fair average for the other estimates. But these estimates perhaps apply more particularly to the greatest storms, while the previous table no doubt includes a rather large proportion of short, tornadolike winds. A mean of the averages is not far from twenty-four hours, and this is perhaps a safer estimate of the average time of a single dust storm. These atmospheric disturbances occur on the steeper gradients of areas of low barometric pressure, and they partake of the progressive eastward motion of these. Their duration at any particular point will hence depend upon their areal extent and upon the velocity of the low area. If the diameter of the dust storm be divided by the time, we will have this velocity, which in this case will be less than ten miles an hour. This is less than half the usual rate of eastward progress of a low area in the eastern part of the United States, but it corresponds more nearly with the rate observed in the Great Basin, where most of these storms occurred.

In nearly every instance where these disturbances have been described some mention is made of the quantity of the material transported by the atmosphere. Nevertheless, it is exceedingly difficult to make any definite estimate in this direction, as no actual measurements have been made by any of the observers. But a number of the accounts are such that comparisons can be made between the phenomena described and some other instances of dust transportation which have come to the writer's notice, and which have furnished some quantitative estimates. The results of such comparisons are here given for what they are worth. In several cases the effect of the dust on the transparency of the atmosphere is noted. It is thus stated that—"It gives the sun a sickly color."—"It is dense enough to obscure the mountain ranges from view" (at a distance of from five to ten miles).—"It is sufficient to allow the sun being viewed with the naked eye."—"Immense quantities of sand and dust filled the air, until the sun became so obscure that it could only be seen as a round ball, at which one could gaze with impunity."

During a high wind on the 25th of March, 1895, following a dry season, the atmosphere over the northern part of Illinois and over a part of Iowa had an appearance which corresponded to the instances here described. The storm lasted about three hours, and during that time an apparatus for collecting dust from the atmosphere was suspended at an elevation of about a hundred feet above the ground back of the bluffs of the Mississippi River at Rock Island, Ill. This apparatus was so arranged that dust could not be taken from a current of air more than a tenth of a square foot in cross-section. It is possible that the actual current was not more than a tenth as large as this. The quantity of dust collected was about two ounces. The wind velocity for the three hours was thirty miles per hour. This indicates that the atmosphere on that day carried a load of one hundred and sixty, or possibly sixteen hundred, tons of dust to the cubic mile of air.

Some of the notes refer to the accumulation of dust and sand in dwelling houses and other buildings, viz.: "Merchants closed their doors to protect their goods" (from the dust).—"The quantity of sand swept from houses (by housekeepers after a storm) showed the severity of the storm the two previous days. The sand penetrated every nook and corner."—"The pattern of the carpet may be obliterated; drifts have been formed on the floor from one to two inches in depth."—"The dust filled every residence completely [!] covering up everything while it lasted."—"The wind hurled a few quarter sections [!] of rich loam into the residences and business houses."

Blown dust is a general and familiar nuisance to housekeepers over the entire West. A minimum estimate, verified by direct

observation, for the quantity of dust settling on floors during such storms is about a fourteenth of an ounce of dust on a surface of a square yard in half a day. A maximum estimate made on the basis of the above newspaper accounts would be at least five pounds to a square yard of surface for a storm lasting twenty-four hours. If we then suppose that a house that is twenty-four feet wide and thirty-two feet long has open crevices, which average a sixteenth of an inch in width and have a running length in windows and doors of one hundred and fifty feet, the wind may be supposed to enter half of these crevices with a velocity of five miles per hour for the time the storm lasts, or for twenty-four hours. The dust may be supposed to settle on not less than eighty-five square yards of surface, including floor space and horizontal surfaces of furniture. The minimum estimate, based on these figures, gives us two hundred and twenty-five tons of dust to the cubic mile of air. The maximum estimate would be one hundred and twenty-six thousand tons.

In the following citations the optical aspects of the dust-laden air are again characterized in a definite way: "The air was so full of sand that it resembled a fog."—"A wind storm struck us, bringing a dense cloud of dust."—"The sky assumed a deep, tawny hue, and fifty yards was the limit of clear vision."—"The dust was so thick and heavy that a person could not see more than a block through it."—"The dust was so thick that it was impossible to see halfway across the street."—"I have seen the dust so fill the air [in a Western dust storm] as to make it difficult to see more than a few rods."—"At times it was impossible to see across the street on account of the flying sand."—"A strong wind was made thick and yellow by flying real estate."—"The wind filled the air with dust as far as the eye could see. It immediately became dark, and lamps had to be lighted."—"During the sand storm it was dark as night, and people ran into each other in their flight through the streets."—"The wind was accompanied by dense clouds of dust that obscured the sky until all was dark as midnight."

From the phrases used it is evident that the transparency of the atmosphere must have been considerably less than when the sun could be viewed through it, or when objects might be seen dimly at a distance of one or two miles, as in some instances previously mentioned. This difference in the two cases is, of course, due to the increased quantity of dust carried by the air. Such conditions as are described here may readily be produced experimentally on a small scale by throwing dust into the air on a windy day. If the quantity of the dust be known, it is necessary only to estimate the degree of opacity produced and the bulk of the air in which the material is dispersed. From a number of

experiments, it appears that two ounces of dust suspended in about four thousand cubic feet of air render it as thick as it must have been, at the least, in the storms described. This would make about two thousand tons to a cubic mile. It should be added that these experiments were made in a wind moving about eight miles an hour, and with dust quite fine enough to be suspended in such a wind. A considerably larger quantity would no doubt be required if the material were to be coarser, such as would be carried by a strong wind. The estimate is therefore believed to represent a minimum for such storms as are described above.

Another perhaps less reliable estimate may be made from accounts which describe the drifting sand, thus: "The sand drifts, as snow does, and has attained such a depth as to cause a fear that vegetation in the simoom's path will be greatly damaged."—"Drifts of sand one foot high were piled up in thirty minutes on a railroad track."—"Cuts [along a railroad] were filled with immense drifts, which averaged about two thirds sand and one third snow."—"At Cheyenne Wells, Colorado, thirteen cars of sand were taken from the depot platform" (after a storm).—"Tracks were obliterated [by drifting sand] and the whole landscape was changed."

Under such conditions it may be surmised that a drift of twenty-five tons of sand might be deposited during six hours from a current of air forty feet wide from the lowest ten feet, in the lee of some intercepting obstacle, as in a railroad cut. In fact, such instances are on record. The velocity so near the ground would not exceed fifty miles an hour. Twenty-five tons may therefore be carried by 633,600,000 cubic feet of air, which makes nearly six thousand tons to a cubic mile. It is by no means likely that all, or even the greater part, of the sand carried by the lowest ten feet of the atmosphere can be left in the drift, and the estimate may again be much too low.

Still another approximation can be made by experimenting on the effects of dust in the atmosphere on the respiratory mechanism of the human body. Such effects are referred to in the following paragraphs:

"The wind sweeps down from the deserts and brings with it sand in such quantities as to almost make breathing impossible."—"The sand was blown in stifling clouds about them."—"During the sand storm the air is so full of dust that it feels as if it were impossible to breathe."

By some simple experiments it has been ascertained that less than two grains of mineral dust suspended in a cubic foot of air interferes with inhalation in a normal way. This would make about twenty thousand tons of dust to the cubic mile. It is pos-

sible that the stifling sensations felt in a dust-laden atmosphere are the results of a cumulative stimulus on the nervous system, and a smaller quantity might produce similar effects. No doubt there is also a subjective factor which will modify estimates on this line.

Lastly, an estimate, or rather a measurement, has been made on the quantity of sand carried in such storms as are recounted in the following items: "The sand is blown about in such quantities that it is not possible to keep one's eyes open."—"A man venturing into a whirlwind of sand invariably returned in a few minutes with his face bleeding with hundreds of cuts."—"Clouds of sand were driven through the air by a high wind, obscuring all objects and rendering existence almost impossible (*sic*) for man and beast."

In 1886 the writer had the opportunity to be in the midst of such flying sand on the Western plains, and to make some observations on the quantity borne by the air. The storm was not as severe as those described in the above paragraphs, nor did it carry as much drift, for neither was the author's facial integument punctured nor did he experience any apprehensions as to the possibility of continued existence. But there was enough of sand in the air to deposit one ninth of an ounce during fifteen minutes in a vial with an aperture measuring one tenth of a square inch turned to the windward. A velocity of twenty miles per hour was probably not exceeded where the receptacle was placed, and this would make the load carried equal to nearly thirty thousand tons per cubic mile.

To sum up: The estimated loads of sand and dust that may be carried by the atmosphere range from 150 to 126,000 tons per cubic mile of air, or from 0·0009 to 0·77 grammes per cubic foot.

Summary of Estimates.

	No. of tons per cubic mile.	No. of grammes per cubic foot.	No. of grammes per cubic metre.
Estimate on a thick haze........................	160	0·0009	0·031
Lowest estimate from accumulation in dwellings.....	225	0·0013	0·048
Estimate on opaque dust clouds..................	2,000	0·012	0·434
Estimate on forming sand drifts.................	6,000	0·037	1·30
Estimate from effect of dust in the air on breathing..	20,000	0·123	4·34
Estimate from a quantity of sand collected in a storm	30,000	0·184	6·49
Highest estimate from a quantity of sand in dwellings	126,000	0·77	27·29

With these figures and the data on the duration and on the frequency of sand storms in the western part of the United States, it seems possible to form some idea of the total amount of work performed by such storms over this territory. It is not believed that the data presented justify any great claims for exactness

for a general estimate, which is made here in the absence of a better one.

If we say that this western country experiences a dust storm twice a year, we do not rate this work too high. During two such days the velocity of the wind for the lowest mile in the atmosphere will average, at least, thirty miles an hour, and the total wind movement will be 1,440 miles. Of course, there are many sheltered places where such winds will not be felt. The territory including the west two thirds of the Dakotas, of Nebraska, Kansas, Oklahoma, and Texas, and extending west to the Pacific Ocean, contains about 1,000,000 square miles of open land, allowing one third the area for mountains. For the time of the storm the atmosphere over this area may be regarded as a current of air 1,000 miles long, 1,000 miles wide, and a mile high, containing 1,000,000 cubic miles of air. If the lowest 200 feet in this current carry a load of 20,000 tons to the cubic mile, and if the remaining 5,080 feet carry 100 tons per cubic mile, there will be 853 tons of dust to each square mile of the whole area of the current, making a total of 853,700,000 tons transported a distance of 1,440 miles, or, if the expression be permitted, 1,229,342,400,000 *mile-tons* of transportation will be performed.

Comparing this with the quantity of work performed by the water of the Mississippi drainage system, we find that the latter is three hundred and thirty times as great. The Mississippi carries annually 406,250,000,000 tons (estimate by Humphrey and Abbott) of sediments a distance of, say, 1,000 miles, performing 406,250,000,000,000 *mile-tons* of transportation. The ratio of the atmospheric transportation in the West and the aqueous transportation in the Mississippi basin is then 1 : 330.

If the above estimates have any significance at all, it is to the effect that in this country the work of the atmosphere is less than the work performed by meteoric waters. So far the inference is in full accord with the well-grounded general consensus among geologists.

Care has been used to not overrate any of the factors entering into the estimates. In sandy regions a considerable amount of transportation is effected by pushing by the wind on the loose surface material. This part of the work of the wind is here entirely neglected. It is known, too, that even on calm days the atmosphere carries an appreciable load of dust, and this has not been taken into account, though it operates for the remaining three hundred and sixty-three days of the year. It is, therefore, possible that the general estimate is too low. But it is not necessary to have recourse to such a supposition alone to show that, locally, work by the atmosphere may exceed the work performed by the water. The observed average wind velocities in these

storms appear to be about twenty-five miles an hour. Velocities two and a half times as high as this are not unknown, and the efficiency of such a current is two hundred and five times that of one having a velocity of twenty-five miles an hour. If the velocity is doubled it increases the transporting power sixty-four times. Should such storms then occur on twenty days of the year instead of on two, the total work would be six hundred and forty times more effective than in the first instance. Still another increase would result from the greater vertical dispersion of the lower greater load in a wind with high velocity. A predominance of aërial transportation may, of course, also be due to local inefficiency of the aqueous work. But this digression is not made for the purpose of proving the possibility of such a predominance in any place. A proof of this would be superfluous, since the topography of sand-hill regions is conclusive evidence on this point. It is merely desired to emphasize the fact that atmospheric work is subject to very great range in its effectiveness, and that as a consequence the great range of the estimates made above does not impeach their trustworthiness.

Some other stray items of information, culled from the newspaper accounts, may be briefly stated in closing. The only statement from which the distance over which dust has been transported can be definitely estimated is in a notice coming from the southern part of California. From the notice made it is certain that dust must have been carried twenty miles. Of course, this does not speak against the possibility of a transportation over twenty times that distance. In one case a slow settling of fine dust from the air is reported as actually observed, and this was also in California. The maximum wind velocities reported in connection with dust storms are few, running from 36 to 90 miles per hour, viz.: 36, 40, 45, 50–60, 90. Some instances of the erosive effects of blown sand are described. It is stated that winds will raise dust on sparsely covered, not cultivated land; that orange trees in California are sometimes girdled near the ground by sand blasts; that the glass in the windows of railroad coaches is etched by impinging sand; and that paint on the coaches is worn off in the same way. The softer wood in telegraph poles is sometimes worn away by sand so much faster than the harder wood in the knots that the latter are left protruding far out. Finally, there are some accounts of the coarseness of the transported material. It is generally fine enough to be called dust, but sand is often mingled with the dust, and occasionally there is fine gravel. Two reports mention pebbles, and in one instance these are said to have been large enough to "knock a man senseless."

To the writer the facts here presented appear most interesting in their incompleteness. While there are tens of thousands of

square miles in the West where the wind has covered the land with monuments of its undisputed reign, the ever-changing sand hills, very little is known as to the quantity of the work performed by the wind in such regions, or as to the relation between this work and prevailing wind velocities. It is evident, also, that a considerable quantity of fine *débris* is removed by the wind in such places, but observations are wanting as to what becomes of this product of trituration after it is raised from the creeping sand, how far it is carried, or where it is deposited. The atmosphere is known to carry appreciable quantities of dust, as already stated, even in low winds, but on this work the study of the dust storms and sand storms has no bearing. The study of the geological work of the atmosphere evidently requires a wider basis of facts.

THE "NEW WOMAN" AND HER DEBTS.

By CLARE DE GRAFFENRIED.

WE delight to glorify the "new woman," the advanced woman. If, however, we study Prof. Otis T. Mason's book, Woman's Share in Primitive Culture, we find the "new woman" to be only a revival of a very ancient type. Prof. Mason says that, for the highest ideals of civilization, in humanitarianism, education, and government, the way was prepared in savagery by mothers and the female clan groups. While men were the inventors of every murderous art, women were the actual inventors of the peaceful arts, and excelled in weaving, pottery, agriculture, the preparation of foods, and the substitution of other forces to do the work of the human muscles. Woman made rough looms. She tamed the present domestic animals. The first empirical physicians were not the sorcerers but the herb women, who collected also the earliest *materia medica*. Savage woman founded all the modern crafts. She was the butcher, the cook and server, the skin curer and dresser, the furrier, tailor, carver, cobbler, the hat and dress maker. She it was who made possible the great modern textile industries. In weaving, dyeing, embroidery, molding, modeling, and painting, in the origination first of geometric patterns and then of free-hand drawing, primitive women elaborated æsthetic art. They were also the earliest linguists, the founders of society as distinguished from savagery, the home-makers, and the patrons of religion.

Undeniably in those days woman was emancipated. In ancient civilizations her industrial skill was astonishing, as among the Egyptians, where, too, her legal and political rights were carefully guarded. But as clan groups made way for larger political

units, as man was less busy conquering and enslaving enemies, he began to enslave his helpmeet, confining her within narrower social bounds, withdrawing from her all share and voice in public affairs, establishing, in short, a social order now known as Orientalism, to some extent characteristic of the Jews through the Persians, and fastened anew on Christianity by the Oriental St. Paul, who preached the subjection of woman. With the decadence of Greece and Rome, woman fell from her high estate of honored equality, and in the dark ages as a social factor she disappeared.

Nevertheless, she was the worker, though receiving no credit for her work. Under the feudal system, when men were bound to bear arms and make constant war, women carried on the trades and arts around the baronial castles, in the wretched homes of the serfs—but not as free agents, only as chattels of their husbands. Later, in the middle ages, all the great industries were controlled by guilds and syndics, which regulated the manufacture and sale of goods, but in which man only represented the working classes. He alone had power, he alone drew wages. Though the exquisite silks, damasks, and embroideries that were the fruit of his loom embodied a dozen kinds of skilled labor performed by his wife and daughters—hackling, combing, carding, dressing, spinning, dyeing, weaving—only the head of the household counted and handled the pay.

Everywhere in Europe and America, before the era of steam machinery, women plied the industrial crafts at home, in towns, in villages, in the country. The conditions under which these domestic industries were carried on were bad, indeed, almost intolerable—in damp, overcrowded habitations, without air or drainage, amid squalor, want, filth, and devastating epidemics. But woman, the most important agent in such productive labor, was economically and politically ignored. She had no power, no voice, no pay; and without money she had no control of her own time or her own aptitudes. In fact, she was very like a slave; and English and Irish peasant girls even sold themselves into real voluntary slavery in colonial times, coming to America as quasi criminals or indentured apprentices, to be household servants and work out their freedom, in order to escape the miserable tyranny of the then prevailing domestic industries.

About the middle of the last century steam was harnessed. The spinning jenny was invented—the first blow at *home* industries. Factories for steam machinery were opened, and women and children were drawn from the wretched cottages to tend first the spinning frames, then the looms, and finally the whole array of textile appliances which during the past century have revolutionized production and again emancipated woman. Steam ma-

chinery found her an economic and financial cipher; it has transformed her into an economic and financial power. The invasion of women and children into the lower grades of paid industries has made possible the advance of females into higher pursuits. Untaught manual workers hewed the way for intellectual and professional workers.

I referred a while ago to the new woman's debt to primitive mothers. I would speak now of the new woman's debt to the real working woman; to her who first leaped over the home threshold and broke the fetters of tradition that confined the gentler sex strictly within the domestic sphere; to the first female wage-earners who dared public opinion, suffered odium, and underwent the hardships inevitable to new and untried conditions in order to open up all the noble crafts, trades, and professions on which the girl of to-day enters without strife or penalty. The multitude of pursuits in which the modern Eve may attain higher usefulness and development, the careers that crown her with honor, fame, and fortune, are a heritage to us of the last decade of the nineteenth century from women and girls who toiled in factories in the last decade of the eighteenth century.

These privileges are not of our creation. Let that fact sink deep and make us humble. Enjoying the fruit of economic liberty, we are apt to forget who won it for us. We are even prone to persuade ourselves that *we* won it, prone to magnify and vaunt ourselves, shutting our eyes to the struggles and tasks of hundreds of thousands of ignorant, despised mothers and maids and tiny children whose lives were one long martyrdom in mills and workshops in Great Britain and on the Continent, in order to render gainful pursuits and the control of their own earnings possible for womankind. All the blessings which we accept as a matter of course—the shortened working day, decent sanitary surroundings, frequent payments—are the outcome of a hundred years of toil and stress, of snail-like legislation following on timid protest, of concessions wrung from careless or hostile public sentiment, until, finally, the present factory acts were secured.

Nothing in history is more dramatic than that bitter industrial revolution by which the factory system displaced the domestic industries. Machinery came to stay. It had to be fed, fed actually with human fuel, females and little ones scarcely out of babyhood being set to tend it in buildings hastily constructed, in barns or barracks on village outskirts and in temporary sheds near cities. When in sparsely settled districts there was lack of small hands to run spindle and loom, the dregs of the population were utilized. Women, and children down to four and five years old, were brought in droves from afar, or taken from almshouses or pauper institutions and even from the prisons. These miserable crea-

tures, let in gangs to the manufacturers, were herded like animals in the mills and forges, sleeping under the machines, eating there such poor food as they had to eat. Tasked day and night and often days at a stretch, they were rudely shaken from brief slumber to renew their work, and were goaded to labor by the whip.

Generation after generation of English factory operatives was thus martyred, devitalized, degraded, before reaction of public feeling and tardy legislation gradually combined between 1802 and 1876 to repress these abuses. So, by toiling sixteen and eighteen hours out of the twenty-four, by living in stables, by being beaten and starved under employers drunk with avarice and power, these early mill hands—grandmothers, mothers, maidens, and tiny children—bought with blood and tears the right for woman to compete industrially with man. In this sad, this heroic effort, a million beings were engaged whose lives were needlessly shortened or sacrificed to the dreadful treatment and surroundings they had to endure before the cry of their pain was heeded by the lawmakers, before a century of suffering, demoralization, and oppression forced into existence that great saving and preventive agency, the British Factory Acts.

The crusade for government interference and protection of the wage-earner against insane and inhuman greed—alas! even the greed that makes parents wreck their offspring by early labor—was carried on for seventy-five years by men alone. I am sorry to count no feminine helper among the reformers, to blazon no woman's name alongside Lord Shaftesbury's.

In the United States the first mill employees enjoyed a better fate. Nevertheless, long working hours, the toil of ignorant children, and other abuses of unrestricted industrialism early called for remedy; and since 1840 Massachusetts has led the ever-widening movement for regulating factories and improving the condition of labor.

The American girl who profits by this hard-won emancipation, to whom has fallen the precious heritage of economic independence, who is able to-day to pursue freely and at ease in laboratory, studio, office, and workshop all the skilled trades and professions only because other humbler sisters have trodden a rougher path and cleared the way by manual effort, this "new woman" owes to all female breadwinners commensurate gratitude and many sacred duties.

First, by virtue of ampler leisure, superior education, and social importance, we owe *protection*. Do we give it? No. It is a significant fact that while in England the Factory Acts were secured mainly by men of rank, wealth, and public spirit *for* the laborer, in America such statutes usually originate with and are pushed through by the workers themselves, half educated, un-

aided, handicapped, and sometimes intimidated by unprogressive employers. When measures come before our Legislatures to better the conditions under which females toil in shops and mills, and to raise the age limit after which the child may be condemned to labor, women, with noble exceptions like Mrs. Josephine Shaw Lowell, are conspicuously absent, while even many clergymen enroll themselves on the side of *laissez faire*. True, our sex is conservative, frightened by prophecies of socialist rule, inclined to regard factory legislation as anarchistic instead of remedial and preventive. Another feminine inconsistency is that women busy themselves and beset the Solons about paupers and the degraded, about institutions and charities, though refusing to lift a hand or lend their indorsement to obtain protective legislation for respectable, self-sustaining working women and helpless children, who from dependence for employment on the favor of merchants and manufacturers are unable to speak in their own behalf. Yet these patient wage-earners, if properly safe-guarded from insanitary surroundings, dangerous and poisonous pursuits, long hours, and excessive strain *while at work*, would so seldom be found in hospitals, institutions, poorhouses, and prisons that the occupation of the board of lady managers would be gone.

Throughout the Union child labor is surely diminishing, as a result of growing public disapproval and of factory laws in half the States; but in large cities and in States that have inadequate factory inspection—practically all except Massachusetts—and no age limit for employment, the mill child and the "cash" child alike are victims of the same evils—low vitality, premature breakdown, dense ignorance, transient employment from shop to shop, and unthrifty habits. Some callings are positively fatal to children; other vocations cause them to be stunted, crooked, or atrophied—a race apart, haggard, wizened, old. The ignorance of working children is often appalling. They do not know their age or birthplace, or the name of the country they live in. They can read and write no language. To say that these little toilers are learning trades is the cruelest falsehood. Whether engaged only in what seem easy and harmless pursuits, standing in stores till eleven o'clock at night in holiday season, in a candy factory one week, in a box shop the next; whether trotting after the mule spinners thirty miles a day, or running forty miles a day fetching and carrying for the glass-blowers; whether tending cutting presses that chop off their fingers, or gilding frames whose metal poison paralyzes their hands, or roasting slowly before cracker ovens, the working children under fourteen years old are nearly everywhere the same—dwarfed, physically defective, mentally benighted, demoralized, unstable, migratory. "Little wonder," says Mrs. Stevens, Assistant Factory Inspector of Illinois,

"that each year finds increasing numbers of wage-earners who can do nothing well, who have no manual skill to command living wages, who in the best times are on the verge of starvation, and at every economic upheaval topple into the abyss of pauperism."

Out of 340,000 children of school age in New York city, 50,000 are untaught for want of school room, because of ragged clothes, or unwillingness to learn. Twenty-eight thousand more children of school age are employed in stores and factories.

Who should act for this toiling army of little ones, should guard the human race from degeneration, should demand the enforcement of existing laws and the making of better laws in their behalf, should secure the building of schools, the expenditure of more money for kindergartens and primary and industrial education, unless it be intelligent women?

Our mission it is, too, to bring about better housing of the poor and the artisan, to insist upon their *right* to decent dwellings, fresh air, pure water and plenty of it, clean alleys and courts and some privacy in their homes—conditions without which those engaged in productive industries can with difficulty lead moral and virtuous lives. It is a mistake to suppose that workers and honest poor folk are satisfied with any miserable abode. Many of them are ambitious. They have the home-making instinct and turn their pitifully small resources to admirable account, surrounding themselves with dainty neatness and refinements in spite of wretched quarters and overburdened lives. I know whereof I speak, having studied the tenements of every large city and many manufacturing centers in the United States. Not long ago I spent four months in a house-to-house, room-to-room investigation of parts of the most congested "slum" districts of New York and Philadelphia. I visited 1,400 tenements, 1,600 families, and 7,250 individuals.

The woman with liberal training, a competence, and social power is the natural guardian of the civic rights of her humble and ignorant sisters, whose civic wrongs she must also have imagination enough to discover by putting herself in the needy fellow-creatures' place, bringing to bear upon their problems her own broader insight and nobler vision. To put yourself in another's place signifies to empty yourself of self. Use imagination, project yourself for the time being into the life of another. *Be* a poor man, an ignorant man, with limitations and the scars of suffering and want, narrowed by lack of opportunity, perhaps embittered by hard treatment and ill success. Be all this, however, *plus* yourself, your brain, your vitality, *plus* your enlightened conscience and your big, deep heart. Then indeed we have a man, not a one-sided mortal, rich and learned *but* nothing else,

or poor, ignorant, and callous, *and* nothing else. The student, teacher, scholar, reformer, or philanthropist is only half a man. He knows principles, but not what it means to pinch and starve, to beg for work without finding it, to see his savings dwindle while capital recoups itself. Piece the scholar or reformer and the workingman together, and we get a complete and useful entity, a being capable of attacking the world's woes without aggravating them. Put yourself in the place of those you propose to aid, and then indeed your help becomes not charity, but brotherhood.

To the least observant it is plain that the manual workers who to-day represent those factory operatives that led us to economic freedom are far less skilled in many branches of industry than were their primitive forbears or their ancestors under the domestic system of trades. Steam-power inventions and appliances tend to change the wage-earners who watch them into soulless, almost brainless, machines. Labor is now so specialized that one repeats endlessly the same process—feeding presses, turning cranks, guiding seams. Reason is stultified, sensibility is deadened. All-around perfected craftsmen exist no more. Who conserves the artistic workmanship, the æsthetic and industrial skill of the primitive female? It is not displayed by our proletariat, certainly, as Prof. Mason remarks; for when we take the exquisite sewing of the Eskimo women, done with sinew thread and needle of bone, or the wonderful basketry and pottery of our American Indians, or the feather work of Polynesia, or the loom products of Africa, and compare them with the tasteless, useless decorations and clumsy needlework of the untrained daughters of our laborers and mechanics, the comparison is all in favor of the wives and daughters of the degraded savage. Household knowledge and pursuits are at the lowest ebb among many of our industrial population. The mothers and girls can neither cook nor sew, nor wash and iron, nor care in the simplest way for the body. Ignorance causes the death of infants and the ill health and poverty of adults, whom poor food robs of their only capital, the power to earn.

Not only over the homes of workers, but over the shops, foundries, mills, and factories, the curse of incompetence hangs. Unless the grade of labor improves, the pay of the skilled workman will be still further lowered by unskilled competition. Our wealth, our greatness, depend on the mastery of industrial arts. It helps us little to be the largest coal-consuming and most inventive nation on earth, if the era of machinery is to be also the era of blind force; if behind the machine we have not the trained hand and eye, the taste of the designer, the skill of the architect and wood carver, the science of the shipbuilder—in short, manual

dexterity re-enforced by art. However we pride ourselves on mere material resources, without industrial power and technique the rest of the world will beat us. Japan and China have developed their exquisite textiles, bronzes, and faïence for four thousand years. Russia has greater oil fields than America. If Egypt and India fail to out-acre us in cotton, Africa could be turned into one vast cotton field where the three economic factors—food, shelter, and raiment—would be minimized, since the cultivator would wear no clothes, would sleep under a tree, and, when he wanted food, would climb the tree and get it.

Clearly, too, we shall continue at an ethical as well as a commercial disadvantage unless we replace the handicrafts of the primitive woman and build up the industrial arts—the all-important, ever-dignified and beautiful pursuits of cooking and sewing, cleaning and repairing, needlework, embroidery, carving, coloring, and house decoration. The most unlovely homes in the world are the bare, untidy homes of our working population. The most wasteful housewife on earth is the thriftless American housewife. To reinstate the skilled industries, to weave in beauty with the life of the people, we must carry manual and technical training and applied art to the point of action, as it were, down among the degraded, the belated, the neglected, the submerged. In the "slums," where ignorance revels, crime festers, and decent poverty hides, we should found cooking, sewing, and housekeeping schools, with carpentry centers, wood-carving, brass-hammering, drawing, modeling, and other creative pursuits that will fascinate the roughest street girl and transform the boy "tough" into an eager, industrious artisan. Belgium and France, whose products we in vain try to equal, have planted industrial and domestic science schools in every hamlet, technical schools in all the manufacturing towns, dairy and farm schools in the agricultural districts. The teaching is adapted to local industries; on the coast, to shipbuilding and fisheries; in the quarries, to stone-cutting; around textile mills, to weaving and dyeing; with drawing everywhere. Hence the industrial supremacy of these countries, their excellent food, absence of waste, national thrift, and the love of art that pervades even the humblest classes. To educate by the same methods the children of America, to improve our homes, to bring order, skill, and beauty into the barrenest lives, to carry on the propaganda for universal industrial and art training, is the privilege and duty of the "new woman."

Two words of warning. Even to dabble in handicrafts and æsthetics is a sign of the crude and amateurish but noble upstriving of our times, just as it indicates awakened civic conscience that club women settle in one hour's discussion the most far-reaching municipal problems and the gravest financial issues.

One fault, however, of modern industrialism is that girls rush hastily, blindly, and sometimes unnecessarily into self-supporting pursuits for which they are unfitted, and to the neglect of a legion of home duties. The desire for pin money, for more to spend on dress than clerks or mechanics can afford their daughters, sweeps into the ranks of competition a whole army of frivolous workers too young to understand the responsibility of the industrial career, untrained for it, and determined to end it by marrying the first *bona-fide* suitor. Such young women, half maintained at home, fond of excitement and of the crowd that congregates in shops and factories, thinking chiefly of self, unidentified with the interests of persisting labor, enter the economic market not on a fair business basis, but accepting any pittance that will supply pocket money and gratify their natural and in some respects commendable desire to make a good appearance. Then, having cut down pay below the life line for the self-supporting toiler, these transients join in condemning merchant and manufacturer for offering no more than starvation wages. Better economic conditions for women will not come until they enter the field less hastily and on strictly business terms; until they are trained enough, stable and responsible enough to deserve these ameliorations, and capable of the concerted and unselfish action required to win them.

Again, the true, the ultimate aim of education is not to prepare for mere self-seeking skill and the acquisition of wealth or social pre-eminence, but for life and a choice between difficult distinctions of right and wrong. The highest life consists in constant development of new aptitudes for usefulness and new faculties for enjoyment; and of this intellectual and moral life woman is the creator and the guardian. Its stage, if she be but a mortal, its altar, if she be a divinity, is the home.

The noblest use for the industrial arts and domestic sciences is to raise our daily living to loftier hygienic and ethical standards. Whether or not outside vocations offer for the sex, or a career independent of marriage be chosen, the true apostle of culture and promoter of industrial skill will strive to lift the popular ideas of sanitation, nursing, food preparation, ornament, beauty, education, and physical development. The "new woman" threatens to turn her back on the home which the primitive woman evolved. But, in reality, all paths revert to it, wherever the rationale of progress may lead her—whether to become sociologist, teacher, artist, writer, practical worker, reformer, or even voter. Only in the restful, well-ordered home does "earth reach its earthly best."

THE BANZIRIS OF THE CONGO BASIN.*

By M. F. J. CLOZEL.

THE territory of the Banziris extends along the northern shore of the upper Oubanghi between the rivers Ombela and Kouango, Africa. They have also a few villages on the southern shore that belong to the Congo Free State. The whole number of Banziris on the north shore may be about four thousand; we lack data for estimating the number of those on the south shore. The tribe is not, therefore, numerically very considerable, and their territorial extension is still less than might be supposed from the number of the population. In fact, they occupy only the edges of the shore. Their cultivated lands are of small extent, and the water is their real element. They deserve attention in the first place as navigators—carriers in a part of the river where steamers penetrate only with great difficulty or do not penetrate at all. They have transported one after another the various French expeditions to the country, they help keep up intercourse between the European advanced posts, and they are a chief resource of the commercial houses in the region. When they are not employed by Europeans they carry on commercial ventures on their own account on the upper Oubanghi and its affluents, or, rather, they undertake long fishing trips to secure a provision of smoked fish for their families. The fishery is furthermore an affair of so much importance to them as to determine real migrations. In the dry season, when the low water uncovers the sand bars of the river, three quarters of the population—men, women, and children—abandon their villages on the land and establish themselves in the middle of the river, where they can fish more conveniently. The provisional establishments set up here do not cost the Banziris much time or material. Their round huts are made of mats of plaited straw, held by a few stakes, and covered by a pointed, thatched roof. The houses in the shore villages, a little larger and more solid, are round like the others and indifferently kept. The real dwellings of the Banziris are their pirogues, and these are their refuges when their neighbors of the tribes to the north press down upon them too closely. These pirogues, hollowed from the trunk of a tree, are usually from thirty to

* Much of the information in this paper was obtained through Bonga, a ten-year-old son of chief Bembe, and very intelligent for his age. The father was one of the most influential men of his tribe, and the first who on the embassy of MM. Crampel and Ponet came to them and accepted the French protectorate. Bonga, after two years' residence with the French, learned to speak the language well, and did excellent and conscientious service as an interpreter.

sixty feet long, from two and a half to three feet wide, and fifteen or eighteen inches deep. Their sides, especially on the bottom, are left very thick for protection when they run aground or strike the rocks in passing the rapids. They are full aft and astern. The prow is surmounted by a small oval platform, cut out of the log, and carved more or less elaborately; on the poop is a small round seat, likewise shaped out of the log. The pilot sits here.

A quarter or third of the whole length, in front, is left free. The three or four polers who propel the boat work in this space. They go and come in file, generally with the gymnastic step, striking the platform, already mentioned, with their feet to give them spring. The passengers and baggage are amidships, and a half dozen paddlemen behind, seated on the sides of the boat, assist the polers in hard places. The crews change places every two or three hours. The management of the long and heavy poles, which, in time of high water, have to be from twenty-five to thirty feet long, is much more laborious than that of the short paddles.

There are generally one or two women on board to do the cooking and keep a fire constantly burning on an earthen hearth in the bottom of the boat. An encampment of Banziris offers a picturesque scene, with the pirogues beached on the shore, the crews grouped on the sand, each around their fire, and the long poles stuck in the ground near them, like so many gigantic lances. On the route in fine weather their songs, and the races between landings, with their lusty cries, and all trying to splash the rival boat, make the hours pass pleasantly. Their boisterous gayety is as wholesome and fresh as that of the young demigods of primitive Greece. They have a sculptural beauty, with their well-developed busts and vigorous limbs, the muscles of which have been well brought out by their rude sailor's life; and their nudity, and even the color of their skin—black, with a coppery tinge like bronze—complete the picture. They show their quality in the hard passages, when the pirogues pass the dangerous rapids, when they throw themselves into the whirling waters to hold the boat up or push it on, and they ward it off with their poles from the rocks at the precise moment when it seemed about to break against them. They are wonderful swimmers from infancy. As soon as he is four or five years old the little Banziri is given as his first plaything a pirogue and a paddle suitable to his size, which he sails alone in the creeks around the village. Their features are pleasant and rounded in graceful curves, with not excessively broad faces, full cheeks, round and shortish nose, not flat, the lips not too thick, revealing admirable teeth, and large black eyes, intelligent and merry. They

seem very much like the ideal savages of the philosophers of the eighteenth century. They address strangers as their friends, and wear the amiable and pleasant smiles of children.

They eat dog-meat with great relish, drowning the animal and cooking it without skinning or dressing it. This meat is rigorously forbidden to the women, who have no part in preparing the dish. They believe, or affect to believe, that it would make women sick. So rigorously is the prohibition kept, that the Banziris wash themselves carefully after eating dog before touching a woman, if only with the tips of their fingers. Schweinfurth maintains that dog-eating is an indication of cannibalism, but the Banziris strenuously deny every charge of that kind. Besides the edible dog, their domestic animals are a few goats and hens. But the basis of their food supply is afforded by the fishery. They cultivate the banana and manioc, and, as accessories, tobacco, sesame, a little corn, and millet. This agriculture is carried on in a commercial way by family or village groups.

We could not learn whether the Banziris have any elements of religion. They wear no amulets and have no visible fetiches. We observed only one sign of superstition among them. Before starting a-fishing they planted some twigs in the ground, put in the midst of them a handful of cowries, and sprinkled them with fat. The ceremony was supposed to secure an abundance of fish to the one who performed it, but I never learned to whom the sacrifice was offered. The political organization of the people is not much more developed than their religious faith. He is chief who has the most wives, children, slaves, pirogues, and particularly who has boldness to carry on transactions with the whites in the best interest of the tribe. On the death of the father the eldest son inherits the pirogues; the other goods are divided, while the lands are the collective property of the village or the hamlet.

Men and women go nearly nude. A little breechcloth of native goods, made of the bark of a species of *ficus* described by Schweinfurth, composes all their dress. The men when they go sailing put off even this little bit of clothes, to avoid soiling it. Girls continue totally naked till they are married; three cowries, a few pearls, or a little bell hanging in front of their bodies and held by a belt of pearls or a narrow leather strap, emphasize their nudity. Beads, in necklaces, in armlets, or pins and beads in the hair, form an important element in the toilets of both sexes.

The young women are very charming. Their type is the same as that of the men, but their features are more delicate, with straight nose, small mouth, and slender but not too thin forms. They are sociable with the whites and make themselves innocently agreeable to them as they would to young men of their own tribe, but always with discretion; and they seemed to excel all the other

negroes we met in strict virtue, in behalf of which they appear capable of resisting the strongest temptations.

Marriage is preceded by a long courtship, with gallantry much after the European style, and takes place usually when the young woman is from sixteen to twenty years old. The Banziri who marries a Banziri girl pays her father with a large number of *guindjas*, or the iron picks that are used exclusively for money. A great feast is then given, during which the women dance and the men drink much palm wine. The bride keeps the house for two months without going to the fields or taking part in any of the household work, while the men do the sweeping and till the garden plot. Polygamy is general, but except with rich and influential persons, the Banziris rarely have more than one free wife. The other wives are slaves. The rejoicings and ceremonies observed on the birth of a child are the same, whether it be a boy or a girl. The parents build a little altar of boughs, on which they sacrifice a hen. They then anoint the child's shoulders with the blood of the victim, pronouncing a formula which may be interpreted as a prayer that the child may be preserved from sickness and disaster. Circumcision is not practiced, and the people are disposed to ridicule the men of the surrounding tribes who use this rite.

On the death of a Banziri, all the men of the village attend the funeral banquet, for which many goats are slain, and which lasts two or three days. If the deceased was a chief, all the women shave their heads as a sign of mourning; two slaves are slain and buried with him, and generally also the one of his wives who is judged least deserving. The corpse is interred in a squatting position in a round pit. A blood penalty is exacted for murder. It can be paid in pearls or by the gift of two slaves. If the parties disagree concerning the price of commutation, a sort of vendetta arises between the families. A thief, if a slave, is punished with death; if a freeman, he is sold on the third conviction as a slave.

The arms of the Banziris are hand knives and throwing knives, assegaies, bows and arrows, and oval shields of osier—all similar to the arms of the neighboring tribes from whom they usually come; for the Banziris have but little enterprise in any arts but those which concern their pirogues and fishing tackle, and would rather buy than make.

The articles of trade most in demand and current before everything else are the little white glass beads called *bayaka* on the Congo. Blue and red ones are accepted, but in small quantities. Cowries, which were in great esteem before the Europeans came, have lost most of their value, though they still have a restricted currency. European picture books, copper armlets, knives, and mirrors might do for presents, but would not be regarded as cur-

rency. Cotton goods will pass in small quantities; and firearms and powder are beginning to be in sharp demand.

The headdresses of the Banziris might by themselves form the subject of a whole article. They are built up by women—the mothers, wives, sisters, or friends of the wearer, who weave plaits, tresses, or cords in the hair of the dandies, and adorn them with beads. There is nothing grotesque about the structure; and the model, chosen with the most accurate taste, is always appropriate to the physiognomy of the patient—a word we can well use here, for it takes about eight months to perfect the dressing.

The hair, parted over the back of the head, is brought over to the sides and made up into a number of small tresses which are crimped and rolled into a considerable truncated cone above and a little behind either ear. The top of the section is formed of a larger tress adorned with beads. A series of braids rolled upon one another in the circular contour gives this scaffolding a very curious aspect.

Particular pains is taken with the two bands forming the outline of a shaven triangle over the foreheads which is very common in Banziri toilets. They are formed of natural hair plaited with leaves of herbs. A square of hair and a square of *bayaka* beads, and then lozenges, form a very graceful design. Other headdresses are less complicated, but in all of them beads are associated with hair in a variety of braids; and this accounts for the time it takes the most skillful hairdressers to perfect their masterpieces. If the elaboration of the structure calls for it, hair is borrowed from slaves or from the dead. The false braid is rolled up on top of the head, or falls gracefully from it. Over the forehead is the shaven triangle bordered with bands of hair set with beads. Sometimes cowries are combined with beads; and the details of the contrivances vary infinitely. Men of war usually wear a tuft of cock or parrot feathers in their hair. After the death of a near relative, pearls, cowries, false braids all disappear, and men and women wear as a sign of mourning their hair as Nature gave it to them.

The Banziris differ in language, customs, and physical appearance from all the surrounding tribes, except their eastern neighbors, the Sangos, whom they much resemble. Opinions may vary as to their origin, but the fact about them that makes them an exception among all the non-Mussulman negroes I met from the Loangos of the coast to the Mandijas and Saras of the unexplored regions is that they are pleasant and their women are graceful.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

ENRICO FERRI ON HOMICIDE.

By HELEN ZIMMERN.

FIRST PAPER.

ENRICO FERRI, the pupil and collaborator of Cesare Lombroso in the science of Criminal Anthropology, which the latter may almost be said to have created, has just published a truly monumental work consisting of over seven hundred closely printed pages and an appendix of over three hundred, in which he subjects to a most searching and minute examination the problem of homicide from the point of view of Criminal Anthropology. In it he treats of the murderer by instinct or from madness, reserving for future treatment the cases due to occasion and passion. This huge book is the result of nearly thirteen years' work, during which it has been often interrupted by Ferri's legal and parliamentary labors. These interruptions have not been without their benefit. As a criminal lawyer he had much opportunity of coming in contact with criminals and of studying them closely, and he is convinced that his work has gained rather than lost from the circumstance of its having been so long on the stocks. He has taken as his watchword Michelet's "La science de la justice et la science de la nature sont une. Il faut que la justice devienne une médecine s'éclairant des sciences psychologiques et physiologiques"; and it is on these calm lines that the whole work is penned. The author's purpose, in writing this book, was to demonstrate the methods by which we should endeavor to study the natural genesis of every crime in order to acquire positive and special knowledge of the causes of criminal phenomena, to deduce thence certain indications as to the most efficacious remedies, which should be at the same time the most effective and the most humane, to be applied against these symptoms of social pathology, to bring into relief more especially those data which will explain the genesis of murder, serve to delineate its psychological diagnosis as it affects each individual who commits it, and hence give the degree in which he is to be feared, according to the anthropological category to which he belongs. Starting from the axiom that the elementary notion of homicide as a criminal fact—that is to say, that the murder of one man by another is totally inadequate to satisfy the demands of contemporary penal science, which has been fundamentally reconstituted by the new methods of positive research—he deems that he must conduct his study to the true origin of these phenomena. Hence the necessity of a twofold inquiry: first, that bearing on the natural evolution of homicide, which includes in its vast domain the

historical evolution that forms the theme of the last chapter, and consequently those which bear on the natural causes of homicide. It is necessary, therefore, to commence with animals and end with man, who is but the last link in the same chain.

Simplifying and generalizing the elementary notions that prevail on the matter of homicide, it may be said that it is the destruction of one animal by another of the same species. Homicide as a criminal fact does not consist in the act of taking life—since killing in order to live is a natural law, and hence is moral—but in killing a being of the same species. All beings of a superior species kill those of an inferior one in order to nourish themselves. The deed becomes criminal only when it is unnatural. This fact of unnaturalness defines it as a crime.

Sociology of late has planted its pioneers in the ranks of zoölogy. This was done by Lombroso in his Criminal Anthropology, and on these lines all scientists work nowadays. These scientific conclusions, which affirm the strict relationship, psychological as well as physical, existing between man and the other animals, every day demonstrates as more true. Hence the embryology of murder must be sought in the obscure depths of zoö-psychology, for it is now certain that the criminal activity of man is only the reproduction of animal criminality, developed and modified by means of intelligence. Homicide is a primitive crime like theft, and can be found in nearly all its forms and variety of motives in the animal world. As in man so in beasts there are races more prone than others to the taking of life, beings who transmit the murderous instinct. The classification of animal criminology made by Ferri can therefore be extended to man. Utilizing the studies and researches in animal psychology made up to the present, the author classifies in convenient grades a goodly number of the most accredited facts, demonstrating how homicide manifests itself in the animal kingdom. These facts are more numerous than would be generally imagined, and well adapted for precise classification. The first group, which relates to the different aspects of the struggle for life, nutrition, social supremacy, and sexual reproduction, deals with the crimes due to the natural laws of existence. The general character of this group presents a minor degree of perversion than those of premeditated ones of the second group, which includes murder determined by an instinct in the species. Animals destroy each other from sexual instinct, for love, maternal affection, for defense, for the common weal, for punishment. With respect to this last motive—punishment—among animals, which some deny, considering it a mere question of vendetta, Ferri maintains that among animals, besides this motive, there exists a more or less exact notion of chastisement. Our author admits that it is difficult to distinguish the sentiment

of responsibility from the fear of punishment, but still he holds that animals have a rudimentary sentiment of responsibility. In dogs this sentiment is far from rudimentary. The theme, however, deserves a more extended study, which in this place would have led Ferri too far afield. In any case, as he points out, punishment is not merely a means adopted by man toward man and animals, but is not unknown among the latter themselves. It is above all among animals that punishments are efficacious as deterrents from crime. If monkeys are so thievish in India it is because they are not punished, being held sacred. On the other hand, no punishment can have any effect on certain perverse instincts which have become organic from long heredity. Therefore, where crime is an inborn organic tendency, the need of substituting segregation for the usual punitive methods is evident, in accordance with the conclusions of science which have confirmed the efficacy of penal substitutes for punishment even in the animal world.

That crime is a natural phenomenon can be still better seen when studying the group determined by an antisocial instinct. Ferri asserts that for man as well as for animals every action is determined by a movement of passion, which will be stronger in proportion to the gravity and importance of the act effected, but it always exists, however imperceptible, whatever be the action, and therefore, in studying criminal activity, the principle now dominant in schools and jurisprudence is erroneous, by which passions in their relation to responsibility are distinguished by the degree of their violence—for example, that an overmastering passion can cancel or diminish the responsibility of the individual. This is an empirical criterion, which in studying criminology in man as well as in animals it is needful to substitute by the more scientific distinction of passions which are useful and passions which are harmful to the species, motives which are social and motives which are antisocial. For crimes provoked by social motives have a natural and juridic character of their own and must be judged apart.

In this group of murders of an antisocial character are included those determined by covetousness, ingratitude, war, personal vendetta, antipathies, anger, and the like, which, whether as isolated motives or as concomitants of crime, bear the stamp of individual perversity. The motor impulse must not be confounded with that thus designated by the classical school of criminalists who, when they do not find the cause proportionate to the crime, invent the stock phrase of bloodthirstiness. Thus homicides induced by vendetta, by covetousness, etc., are, according to them, acts of bloodthirstiness. On the contrary, the experimental study of delinquency reveals that homicide without apparent or

proportionate motives is nothing else but the result of abnormal or diseased organisms. However, this factor of bloodthirstiness might better be classified by itself. Perhaps (among the animals who are criminals born), although it has a no less legitimate place among those crimes induced by antisocial instincts where Ferri has placed it, it has also no connection with madness. The classical divorce of crimes from insanity, rejected by positive science, finds also here in the study of innate or acquired bloodthirstiness a heavy defeat. Just as there are good and domesticable animals, so there are perverse ones even among the domesticated, absolutely comparable to the criminal born, as Lombroso and others have contended.

This group of facts brings still more into relief the fundamental analogy between the criminal activity of animals and of men. A yet more eloquent proof is found by studying the group of murders induced by mental alienation and by cannibalism. From *l'homme machine* of Descartes we have come to insanity among animals, concerning which there is no manner of doubt, seeing the result of recent studies, and this means that brutes have in common with man various mental maladies, differing only in degree.

Ferri divides into five categories the cases of murder among animals determined by madness, no matter whether transitory or permanent, innate or acquired: murder by hereditary tendencies, by mania, by impulse of fear, by senility, by alcoholism (for the effects of alcohol in all its divers forms on animals are well known), and subjects them to a brief but deeply interesting examination. All the murders enumerated have their scope and limit in the murder of their fellows. In animals, as we also see among savages and even among civilized peoples, crime is continued with outrages on the corpse and with cannibalism. The origin of this unnatural mode of alimentation must certainly be sought in the need induced by hunger. It is only after that that cannibalism becomes an organic tendency in animals and man. However, man has motives for anthropophagy different from those of animals. Ferri classifies cannibalism among animals in two categories, simple cannibalism (wolves, rats, etc.; Lombroso also cites the case of a dog), and cannibalism among relations—that is to say, infanticide and parricide (crocodile, fox, etc.). To render this exposition of crime in animals yet more complete, the author hints at another possible class, suicide, which is certainly not unknown among animals.

Having thus passed in review all the categories of crime in animals, Ferri devotes a chapter to drawing from the facts he has accumulated their obvious and special conclusions, pointing out the striking psychic analogy of motive and of execution existing

between the human and the animal world, once more insisting on the undoubtedly natural character of the crime. He then passes on to examine homicide in primitive savage humanity, which is an intermediate form of homicidal evolution between the animal and civilized society. Concerning the importance of these studies of savage peoples, as well as concerning the modern reconsideration of the conditions of primitive humanity deduced from the study of contemporary savages, doubts have been uttered and objections raised even in the ranks of evolutionists. Ferri, however, who is convinced that the paleontological data can, for lack of other evidence, be elicited from these analogies with contemporary savage life, accepts the evolution hypothesis that in contemporary savages is seen reflected a large portion of the primitive conditions of humanity.

The purely descriptive style adopted by Ferri in his study of animals in the second chapter of his book is interspersed with psychological reflections, for though at the outset his purpose was to prove the existence of criminal murder among animals, he had also to study not only the manifest existence of this murder, but to show that such acts have their moral as well as their juridic side. To do this he examines and classifies divers forms of homicide in primitive humanity, beginning with the least fierce and ending with the most repulsive, while leaving aside those common also to civilized man. Here we find new criminal aspects: for example, abortion; infanticide, elevated to a custom and a method in Malthusianism; the killing of the old, of women, of the sick, of those unable to work, of useless mouths (practiced also in historical primitive times), homicide for superstition, race hatred, vanity, homicide without apparent purpose, for bloodthirstiness, frequent in savages by reason of the very brutality of their nature and the small account in which they hold their lives; finally, cannibalism, the most repugnant and ferocious form of homicide, common to all the peoples of antiquity according to Vogt; born of hunger, of warlike fury, of need, and transmitted by heredity, by religious tradition, and lastly, the ultimate grade of human ferocity, by gluttony. We see this crime reappear in part and without the stimulus of hunger, for vendetta and simple anger.

This classification of the various forms of homicide presented by Ferri in a growing scale of ferocity, in order to give contrast to the two extremes of primitive and civilized man, does not tally, as he himself points out, with the duplex process of natural evolution which can be studied in primitive man. In fact, here we have on one side a continual diminution and disappearance of the most repulsive forms of crime, and on the other side the ever-increasing development of moral sentiments and of the juridic instincts, such as we find afterward in history. Some forms of

homicide, such as cannibalism, blood revenges, etc., where they do not entirely disappear, become less frequent, are less tolerated, and assume more moral and juridic aspects (juridic homicide and cannibalism as a punishment for evil-doers), and this new aspect constitutes the embryo of the succeeding social right of repression.

After this extensive analysis Ferri thinks he is justified in asserting that savages do not entirely ignore any notion of crimes and of punishment, and if some peoples lack the sense of crime, the majority consider as punishable a certain number of criminal actions, although no doubt these are few as compared with the number existing in our actual codexes. After this review of primitive homicide, although the ethnographical study of criminality and legislation is still incomplete, Ferri believes he may draw various conclusions, of which the most important are: "As among animals, so among savages, these more or less atrocious facts are not alone the effects of specific race tendencies, but also occur among gentle peoples and those relatively less savage. The moral and juridic evolutions against homicide exist hardly even in embryo among the most savage tribes, any more than among animals, and follow, like any other psychological manifestation, the slow evolution of human society. . . . Justice in the moral and juridic sense is essentially relative and variable." As a general and definite conclusion of these preliminary examinations of savage humanity and animals in the order of their criminal activity, it follows, contrary to the affirmation of the schools, that neither punishment nor social innovations will ever succeed in extirpating homicide. But this ideal may be reached rather by the slow labor of progressive evolution.

This interesting examination of the natural evolution of homicide is followed by an inquiry into its natural causes. This second scientific examination needed to be subdivided on the basis of the classification generally adopted by the others (anthropological, physical, and social factors) into three special studies. The combination of the factors among themselves, and the respective prevalence of one of these, determined a special category of crime. Thus the prevalence of the anthropological factor gives us the figure of the murderer born and the murderer by insanity, the main subject of this large work; the prevalence of physical and social factors furnishes us with the figure of the murderer by occasion and by passion, which is to form the theme of the second volume. The anthropological factor in the criminal divides itself yet again into its constituent elements of organic and psychic.

Ferri begins with the examination of the organic constitution of homicide, objecting with great force to the criticisms and methods of the modern school of anthropology and exposing the criterions by which he himself has been guided. It is not easy or

possible, however, to deduce even from these precise criterions anything but an approximate conclusion. Ferri points out frankly, in the brilliant treatise that precedes his study of comparative anthropometry, the difficulties of such classification. He insists, for example, that, besides craniological characteristics and the qualities inherent in the individual and the race, due regard must be had to psychological conditions.

DOGBANE AND MILKWEED.

By MAUD GOING (E. M. HARDINGE).

THE story of the trap-setting and insect-eating plants is a more than twice-told tale. The pitcher-plant, which beguiles the hapless fly to his drowning in its vase-shaped leaves, baited on the outside with nectar-bearing glands, and filled with water; the Venus's flytrap, which shuts up on him and crushes him; the sundew (*Drosera*), which chokes him in a sticky secretion, are all known, at least by pictures and descriptions, to the tyro in botanic study. And we have learned that they all have good and sufficient reasons for thus dealing with the hapless flies. For "the plants grow," says Grant Allen, "in places where the marshy and water-logged soil is markedly wanting in nitrogen compounds. Insect-eating leaves are thus a device to supply the plant with nitrogen by means of the foliage, in circumstances where the roots prove powerless for the purpose."

The insect slaughter which they carry on has the same excuse as the animal slaughter of the abattoir. It is killing for food, and the insects which these plants catch are honestly eaten and digested. But in the infinite analogy of the vegetable world we find a curious parallel to killing for sport. There are a few native flowers which entrap insects simply and solely, it appears, for the deed's own sake. The prisoners serve no apparent use in the plant's economy, nor do their poor little corpses nourish the plant's life. A botanist who let his imagination run away with him might accuse the guileless-looking flowers of that savage joy in another creature's pain which drew our forefathers in crowds to the badger-drawings and bear-baitings of bygone times.

One of these flower tormentors is the spreading dogbane (*Apocynum androsœmifolium*), which is common all summer, along shady roadsides and around the borders of thickets, in the Northern and Eastern States. The plant is about three feet high, erect and branching. The flowers are nearly as large as single blossoms of the lily of the valley, "and are very beautiful," says Mrs. Dana, "if closely examined. The corolla is bell-shaped and cleft, at the

edge, into five slender points. Its deep pink veining suggests nectar," and the insect visitor is not disappointed, for at its base are five nectar-bearing glands. These stand in a ring around the pistil, and in a larger circle, outside the ring of honey glands, are the five stamens. The anthers stand erect, and in shape are like arrow or spear heads. Corresponding to the two points at the base of a spear head, there are, at the base of each anther, two little hard horns, and the stamens ring so closely about the pistil that horn is pressed against horn all around the circle.

On the inside of the corolla, near its base, are five triangular callosities, with their points up. These are placed in such a way as to alternate with the stamens, and stand a little below them, so that the two hard points at the bases of two neighboring anthers, and the hard tip of the callosity—three little horns—come together like the teeth of a trap. There are no fewer than five places inside the flower's cup where these traps are set, and inside the circle of traps are the glands which contain nectar. The flower is visited by bees and flies.

The insect caller must run his proboscis in between the long anthers, and just above the horny excrescences on the corolla. When he attempts to withdraw, after drinking his fill, the three points lock together, like the jaws of a trap, holding the tip of his proboscis in durance vile. If the winged captive is big and strong, he gets free, with a long and a vigorous pull. But small flies are often held prisoners till they die, probably from starvation. Sometimes one may see three or four of these hapless victims on one full-blooming plant of spreading dogbane.

Among the prisoners one may often see a little summer fly of dudish aspect, with body ringed with alternate bands of bronze and gold, and wings of gauze shot with opaline colors. To what end is this bright little fellow sacrificed ? Held as he is by the tip of his proboscis, his body does not come in contact with the plant, and hence it can not be digested by the vegetable juices, as are the corpses of the sundew's victims. The dogbane is apparently unable to furnish any adequate justification for his taking off.

There is another variety of dogbane, the Indian hemp, or *Apocynum cannabinum*, which bears smaller blossoms than the *androsœmifolium*, blooms somewhat later, and is more widely distributed over the country. This flower has no callosities in its corolla, sets no snares for insect victims, and is apparently quite innocent of the crimes which one is inclined to lay to the charge of its first cousin.

The common milkweed (*Asclepias cornuti*) also imprisons insects, which sometimes die in captivity, and do no apparent good to the plant by their deaths. They have, however, invited misfortune, for though the milkweed is rich in honey, and is visited

by a large and miscellaneous company, it can be fertilized apparently only by bees and perhaps by a few large flies.

The milkweed is a peculiarly constructed and very highly organized flower. The petals, five in number, fold back as soon as the blossom opens and press their backs against the flower stalk. Inside them, standing upright in a ring, are five honey jars, or nectaries, of peculiar form. Each nectary is hooded, and inside each is an incurved horn. Within the circle of honey jars are the five stamens, which are fixed to the base of the corolla, and stand in contact with each other, surrounding and inclosing the pistil. On top of the ring of stamens is a large five-sided disk, which keeps the pollen from being blown away, or wet with rain or dew. The whole stamen system is like a little tub or firkin, standing in the midst of the flower, upside down. Inside this firkin are two green pistils, which will be two green pods. The pollen of each anther is collected into an Indian-club-shaped mass, which is fastened to a similar mass formed by the pollen of the next anther. Thus the two connected pollen masses belong to two separate stamens. They are united by a tiny black disk. This disk is set just above an opening between the stamens which runs "clear through" to the pistil inside the firkin. The fly or bee stands on the outside of the firkin, and, tramping about there, gets her foot caught on the black disk—which is glutinous—and pulls out (if she is strong enough) the whole affair, disk and attached pollen masses. A bee will gather three or four of these at once, and I have seen one buzzing away from a head of milkweed loaded with no fewer than nine. Thus encumbered, she was for a moment held prisoner by the flower, unable to pull herself and her burden loose. Following the custom of bees, she carried the pollen masses at once to another milkweed plant, and perched upon one of its flowers in exactly the position in which she had stood when visiting the first. This brought the pollen masses on her feet exactly into the slits running through the stamen ring to the pistil.

The bee seems the favorite guest of the milkweed. The pollen masses come out at once at her tread, and are carried directly to the pistil of another flower.

Wasps visit the milkweed for its honey, but I have never seen them withdraw the pollen masses. Flies seldom do, though the flower is visited by flies of many species. Indeed, it is a general favorite, standing in the midst of a winged throng till dark, for twilight brings to it a number of small, dark-colored moths with very long proboscides.

But not all these visitors are permitted to go in peace. A small fly with his legs stuck to the black disks is frequently unable to pull himself loose after he has drunk his fill. On a bunch of

twenty-five blossoms I have counted five flies thus held in captivity — three dead and two dying — and the same bunch had captured a long-legged, lace-winged caperer, whose struggles to free himself were as desperate as futile. On any large bunch of these flowers one can see mementoes of past tribulations. Here and there a blossom still holds a little black leg, the price of the liberty of some insect who has gone off free, but a cripple.

A flower so highly organized as the milkweed seldom receives and nourishes all comers. In one peculiarity of structure the milkweeds are like the orchids, that royal family of plants, for the orchids also send their pollen abroad massed into two clusters, which are united by a disk. But each orchid has its own very select and small circle of guests, and some among them endeavor to please one butterfly or moth friend, him and him alone. They are, in evolutionary language, "highly specialized."

On the other hand, a flower which keeps open house to all comers is generally primitive in color and structure. Such blossoms are apt to be yellow or white, with flat, open corollas, and without spurs, honey jars, or covering to protect the pollen. So the milkweed is something of a problem to the evolutionary botanist. Can he, for example, explain the fate of those hapless flies which, like Haman of old, come to a feast, but get only imprisonment and death? These unfortunates are but a small proportion of the milkweed's fly visitors. The great majority make off, after taking their fill of nectar, without carrying off any portion of the pollen which the flower is endeavoring to send to its neighbors. This waste of nectar is bad for the milkweed, which would be better off with fewer fly visitors. So the flower would profit by any device which would discourage these many flies, without deterring those useful and desired visitors, the bees. Will flies learn after a while to shun the milkweed's dangerous sweets, so that they may all be left for worthier and more welcome guests? And how many generations will it take this proverbially foolish insect to lay the lesson to heart?

A SUBSIDY of one hundred thousand francs has been voted by the Belgian Chambers for the expedition to be led by M. Lieutenant de Gerlache, co-operating with the Belgian Geographical Society, into the antarctic regions. Two seasons are to be spent in the expedition. In the first season, M. de Gerlache will attempt the exploration of the regions around Graham's Land. Then, after wintering in an Australian port, the Belgica, as the vessel is to be named, will sail for Victoria Land, and an effort will be made to determine the southern magnetic pole. While he will reach as high a latitude as he can, M. de Gerlache's chief aim will be to collect data relative to meteorology, terrestrial physics, oceanography, and the fauna and flora of the regions explored.

A CAMBODIAN PRIMARY SCHOOL.

By M. ADHÊMARD LECLÈRE.

THE Véat, or Buddhist monastery, is in Cambodia very much what the Christian monastery was in Europe in the middle ages—a community of persons devoted to religion, having a chapel, a place of entertainment for strangers, and a school for boys. The schools directed by the mendicants are most generally primary schools, where are taught gratuitously and in a spirit of charity to voluntary pupils reading and writing in the Cambodian language and characters; prayer in the dead language of Maghada (or Pâli), which has become the sacred language of the Buddhists of the Southern Church; reading of the *Balery Mokoth*, or Maghada texts, which are written in Cambodian characters on palm leaves; arithmetic; and a little religious morals on "earth to earth."

The superior of the monastery is the chief professor and exercises a general direction over the other professors and the pupils, without personally giving much attention to the instruction. Under him is a monk known as the reading professor, who reads on festival days, in the temple or in the hall of the monastery, from the sacred book, the life of Buddha and a few fragments of his teaching, and in the absence of the superior supervises the observance of religious discipline. The other monks, generally spoken of as gentlemen of the clergy, or of the assembly, or of the church, are addressed by the pupils as the professor or my professor.

All the bonzes can read and teach reading, but there are many who hardly know how to write and are absolutely incapable of reading aloud in the assembly of the faithful. Only a few of them are so advanced as to comprehend what they read without pronouncing the words. In short, although the instruction given in these institutions is very elementary, and there is absolutely no discipline, the Buddhist monks are nevertheless the veritable and only teachers of children, their beloved and respected schoolmasters, and their spiritual fathers, to whom it is "good form" to be submissive, the respected educators of the people.

The pupils are of two kinds—those who are dressed like the laity and those who are dressed like the bonzes. The former are designated by terms meaning children who study, who learn, or pupils; the others are novices. But those of both classes who are of the same age pursue the same courses. Those of the second class, the novices, are incipient bonzes. They accompany the monks who go out in the morning to beg, and, like them, hold out the wooden contribution boxes for the alms of boiled rice. Fur-

thermore, having been consecrated with a little ceremony which does not always take place in the temple, they are obliged to have their heads shaved like the bonzes and to recite with them certain prayers which they have consequently to learn, and they live in the monastery. While the ordinary pupils may sometimes reside in the monastery under special conditions or for special purposes, they usually live with their parents, and resort every morning to the Véat to take their lesson, go home to breakfast, then return to study and perform a few household duties and play with their comrades for a large part of the day under the eye of their kindly and somewhat too careless professors.

All children who present themselves at the Véat for study are received. It is not even required that their parents bring them or visit them. The newcomer chooses his professor, and, if accepted, begins at once to study under his direction, installs himself in his cell or in the school hall, and becomes his servant. If the professor has already too many pupils, he refuses the new pupil and advises him to choose another teacher; sometimes he guides his choice, directing him to a master who has few or no pupils, or takes him to the superior, who will select a teacher for him. The choice of a professor is always a grave affair, because it is held in Cambodia, as in all Buddhist and Brahmanic countries, that professor and pupil are bound by strong ties of spiritual affinity, and that the pupil ought to respect his master as he does his father and mother. The law inflicts the same penalty upon an offense of the pupil against his master and an offense by a son against his father and mother, and it prescribes that in certain cases the pupil may be the heir of his professor when he has cared for him or supported him or served him when studying under his direction; not only a family bond, but a religious bond, too, is established between them, for the professor makes it his business to teach his pupil the course by which he may earn a more advantageous reincarnation and reach the Nirvana, and becomes his spiritual guide.

Four implements are used in studying: a tablet about two feet by one, blackened with black lacquer; a crayon stick; a bamboo ruler as long as the board, with which to draw the lines at which the tops of the characters must stop; and a cloth for wiping the board when it is full. The pupil generally uses the corner of his scarf or girdle for the last purpose.

The teacher writes on the tablet the characters the pupil is to learn, and names them to him; the pupil learns to write and name them all at the same time. His professor is near him, answers him, draws his attention to the often inconspicuous details that differentiate the characters, and to the accents and

marks that modify their value, and shows him, writing on the tablet, how to draw them.

I have often witnessed these lessons, and have much admired both the calm patience of the master and the readiness with which the little Cambodians learn. Their memory is extraordinary, and they keep what they have learned much better than our children do. I do not mean that they know better what they know, and that they can draw on a larger part of their knowledge than our children. No, the little that they acquire thus so rapidly continues with them nearly always as unemployed means, as material not put to use, as unproductive elements of knowledge. Their intellectual development in other respects stops early, between sixteen and eighteen years, but their memory still remains surprising. By memory I mean the recollection of sounds, of the eyes, of figures, of words, and of facts. But they do not know, or only know imperfectly, and hardly learn after eighteen years, how to use what they know, to co-ordinate it, to deduce, to draw logical consequences, to generalize; to give their whole mind to a thing. But good sense, delicate discrimination, mingled with some degree of critical judgment regarding all the affairs of current life, are not wanting in them, even in early childhood.

The first series of characters traced by the teacher includes twenty-four vowels, consonants, and diphthongs, and is called the *nomo*, from the two characters, *no* and *mo*, with which it begins, and which together form a Pâli word. These two characters are followed by four others, *pont, théa, sét,* and *them,* which with the first two form the phrase *Nomo Buddhaya siddhan!* or, "Glory be given to Buddha!"—a salutation which resembles that of the *Croix de Dieu,* or "Cross of God," with which French pupils in the *a b c*'s were formerly accustomed to begin their lessons. The pupil, having learned to read and trace the twenty-four characters of this series, is given the thirty-five characters of the second series, which include various consonants and semi-vowels; then the vowels are given—eighteen hard and eighteen mollified, although the difference is very slight.

These lessons thoroughly learned, the pupil passes to the six hundred and fifty combinations of consonants and vowels, which are very rapidly learned, for the same rule prevails with the combinations of each and all the consonants; so that, when one series is learned, the rest are like it.

When the pupil, after two or three months at the most, has learned all the characters and their combinations, a little *sutra,* or manual, or treatise on correct morals is put into his hands, which he reads in the presence of the professor or one of the better learned pupils, who corrects him and drills him in the good reading of the work, explaining the meaning if he does not under-

stand it. The first *sutra* is the "Custom of Youth," and is repeated every day till it is read without hesitation and without mistakes, and till the pupil knows it by heart and can recite it from memory. Then a second *sutra* is given him—the advice of a grandfather to his grandson, or the "Groups of Customs"—counsels to be followed every day; or the "Customs of Women"—and this book is read till it is as thoroughly learned as the other.

Nothing can be more curious than to attend one of these readings. The pupils are all seated on mats near the door or the windows, each with a different *sutra* in his hand. They read all at once, as loudly as they can, so that they can hear themselves better, without any concern for their neighbors, and without stopping to breathe. It is deafening, and we can hardly understand how the poor little fellows manage to isolate themselves from the uproar of noisy readers that can be heard a thousand feet from the monastery.

Between times the pupil copies extracts from the things he reads; practices in writing a letter, or drawing up a brief, or in setting forth some claim in a good, clear style. When so far advanced that he can give up his wooden slate and the tracing of large characters, he is given some folding books. He polishes the pages of pasteboard or felt with sand; then holding an iron-pointed stylus, with his hand resting on a cushion, steadying the stylus with the thumb of his left hand, he draws it carefully over the page, so as to cut the fiber without tearing it. When he has written on both sides of his long sheet—eight or ten perpendicular lines—in this manner, he takes some ink made of soot scraped from the bottom of the pot and moistened, rubs it with a cloth across the leaf, and then wipes it with a clean dry cloth. The ink remains in the hollows, and the characters come plainly out, as black as our printed characters. The number of those, however, who succeed in learning the more delicate art of writing on palm leaves is comparatively small. After the pupil has learned to write, he is taught such arithmetic as he is supposed to need, including the multiplication table and the four rules.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

MR. WALTER B. HARRIS, in his travels in the region of the Atlas Mountains, observed a peculiar native taste or talent for sculpture among the Berbers. "At Dads," he says, "I saw children modeling in clay little figures of men on horseback, . . . which no Arab or Moor either could or would do. Excellently modeled they were too. I asked a native, and he laughingly replied, 'We all did that when we were small.'"

SKETCH OF SAMUEL LUTHER DANA.

SAMUEL LUTHER DANA, the second son of Lucy (Giddings) and Captain Luther Dana, was born July 11, 1795, in the town of Amherst, not far from Nashua, N. H. He was descended from Richard Dana, who came to this country and settled in Cambridge about 1640. His father was a native of Groton, Mass., and in the latter part of the Revolutionary War entered the navy of the United States as a midshipman, he being then seventeen years of age. Soon after his marriage in 1788 he took up his residence at Amherst and engaged in mercantile business. This not proving successful, he took to the sea again, becoming a shipmaster in the merchant service. He followed the sea until a few years before his death, in 1832, and made about seventy voyages to ports in Europe, Asia, and America. Captain Dana was fond of knowledge, and took pleasure in collecting objects of natural history, many valuable specimens being given by him to the Marine Museum at Salem, Mass. He had no faith in the superstitions with which seafaring men are haunted, and rather preferred to go out of port on Friday. On one of his most successful voyages he left Salem on a Friday, called at two European ports, reaching and leaving both on Fridays, and it was on a Friday that he finally reached home. His daughter-in-law, Mrs. James Freeman Dana, has described him as "tall and well formed, with a sensible, frank, cheerful countenance. He had clear blue eyes, dark-brown hair, which became silvery white at an early period of life, and a fair complexion, somewhat embrowned by exposure." She also speaks of him as ever ready to assist any who might require aid—one whom the weakest or lowliest might appeal to with the certainty of receiving a kind response. Lucy Giddings was married to him when she was sixteen years of age. She was very handsome and vivacious, and managed the affairs of her home and family during her husband's long absences at sea with rare judgment and tact.

As Captain Dana's residence was not confined by his calling to any particular place, he changed it twice for the benefit of his boys. In 1804 he removed to Exeter, N. H., in order to give them the educational advantages of Phillips Academy, and five years later, when the two oldest had been prepared to enter Harvard College, the family removed to Cambridge. Samuel passed through college in the same class with his older brother, graduating in 1813. From a pamphlet privately printed, containing memoirs of several members of the Dana family, it is learned that the two brothers were endowed with the same love for natural science, and entered upon the study of certain branches of it with great

enthusiasm. They often made excursions together on foot through the country lying within thirty miles around Boston for the purpose of examining its geological structure and collecting mineralogical specimens. The result of these researches was a volume on the Mineralogy and Geology of Boston and its Vicinity, published by the brothers about the time they completed their medical studies.

The younger brother also employed himself upon these excursions in searching for entomological specimens, and formed quite a large collection of beautifully prepared insects. This was afterward given to the Linnæan Society of New England, of which the brothers, if not the founders, were among the earliest members. Another taste which formed a strong bond of union between them was their love of music. In college they belonged to the same musical societies.

On graduating from college Samuel began reading law with his uncle, Judge Samuel Dana, then residing in Charlestown, Mass. The War of 1812 was in progress, and young Dana caught the prevailing military spirit. He applied for a cadetship at West Point, but received instead a commission as first lieutenant in the First United States Artillery, with which corps he served in New York and Virginia until the close of the war. In June, 1815, the army was disbanded and Dana resigned his commission.

A younger brother, Nathaniel G. Dana, was a cadet at West Point during the War of 1812, graduating in 1814. He remained in military life until his death in 1833.

Samuel did not return to the law, but took up the study of medicine under Dr. Bancroft, of Groton. Receiving his medical degree in 1818, he began the practice of his profession in Gloucester, Mass. The next year he married Ann Theodora, daughter of Rev. Joseph Willard, D. D., who had been President of Harvard College from 1781 till his death in 1804.

Dr. Dana now took up his abode in Waltham, Mass., where he practiced medicine until 1826. Toward the close of this period he established a laboratory for the production of sulphuric acid and bleaching salts. This enterprise soon developed into the Newton Chemical Company, of which he was chemist till 1834. His friend Dr. A. A. Hayes, in the memorial pamphlet of the Dana family, has testified to his wide knowledge of the properties of substances and his great fertility in original devices for general and technological work. In his manufacture of acids and other chemicals improved plans and processes were early employed, and Dr. Hayes mentions especially Dana's device for deoxidizing manganic oxide by heating it with sulphur in order to form from it (with pyroligneous acid) a crude manganous acetate, then largely used in dyeing a fast brown.

The second of Dr. Dana's published writings was issued in 1833, while he was on a visit to England. It was a clear exposition of the chemical changes occurring in the manufacture of sulphuric acid.

In the following year Dr. Dana became resident and consulting chemist to the Merrimac Manufacturing Company at Lowell, Mass., in which position he remained for the rest of his life—a period of thirty-four years. The improvements which he introduced into the processes carried on in the mills of this company were many and important. Dr. Hayes gives an outline of these. He undertook systematic researches on the action of the dung of beeves—then used for removing the excess of mordant in printing calicoes with madder—which resulted in the discovery that crude phosphates in a bath with bran are a complete substitute for the expensive and disgusting material before deemed indispensable. Arseniates, which are cheaper than phosphates, were afterward substituted for them on the suggestion of Mercer, and are the world-wide reliance of print manufacturers at the present day.

Of the same systematic character was his study of the chemical changes involved in the process of bleaching cotton fabrics preparatory to printing them. This inquiry resulted in his inventing a method which not only received high commendation as scientific work but was universally adopted in practice. As most of Dr. Dana's researches were made for the exclusive benefit of the company with which he was connected, their results were not always published promptly, and hence the abilities that might have won a high meed of fame remained known to only a small circle. His discoveries with respect to bleaching cotton, however, were published in the *Bulletin de la Société Industrielle de Mulhouse* in 1838. The principles therein established have led to the American method of bleaching, of which Persez, in his *Traité de l'Impression des Tissus,* says that "it realizes the perfection of chemical operations."

The Merrimac Mills were at first run by water power alone, but when the works were extended this was supplemented by the use of steam. Dr. Dana was now called to the new field of engineering, in addition to his other duties. His development of the whole subject of the evaporative power of coal and the economical disposition of the heat in steam and in water of condensation is a masterly effort, embracing every detail, and was in advance of any published results of the time.

For several years before he became a resident of Lowell, Dr. Dana was frequently called to that city as a consulting chemist. He was also one of the chemists consulted by the water commissioners of both Boston and New York prior to the introduction of the Cochituate and Croton water respectively.

"While these varied applications of science to most useful purposes were daily occupations," says Dr. Hayes, "he was pursuing in his laboratory the great study of his life—madder, its products and its application to dyeing—year after year. He deemed the subject exhaustless, and while following the published results of other laborers in the same field as test trials, I happen to know that the most important discoveries, from time to time, were made by him, and often applied, before their publication by others.

"The laboratory, in most busy moments, was exceptionally neat; the deft handling of the apparatus and order of experiments expressed the system of thought."

Soon after removing to Lowell, Dr. Dana became interested in the action of lead upon water, and made a report to the City Council of that city on the danger arising from the use of lead water pipes. His translation and systematic arrangement of the treatise of Tanquerel on Lead Diseases was considered an important contribution to medical knowledge. The discussion of the lead-pipe question gave rise to several pamphlets from Dr. Dana's pen.

Another division of chemistry in which Dr. Dana did valuable work was its application to agriculture. As the outcome of a comprehensive series of experiments and observations, he published, in 1842, The Farmer's Muck Manual of Manures, which was the sheet anchor of libraries in the rural districts of New England for many years. The next year an Essay on Manures submitted by him won the prize offered by the Massachusetts Agricultural Society. He carried into his agricultural investigations the same scientific methods that he had found so important to success in other technical inquiries, and added an overflowing love for the pursuit in all its varied bearings. The younger Silliman wrote of him: "In point of time, originality, and ability, Dr. Dana stood deservedly first among scientific writers on agriculture in the United States."

The fourth edition of the Muck Manual was published in 1855. Its preface states that "the author is not an agriculturist; he does not assume the name even of agricultural chemist," and mentions his position at the works of the Merrimac Company. "While pursuing there," it continues, "during the years 1835, 1836, and 1837, researches on the action of cow dung in calico dyeing, he pushed his inquiries, as a recreation, during his few leisure hours, into the nature and action of manures and of soil. Conversation on these matters with the geological surveyor, and with the agricultural commissioner of Massachusetts, led to a correspondence between the parties, which partly appeared in the published reports on the geology and agriculture of Massachu-

setts. This induced some zealous and active citizens of Lowell to ask me to deliver a course of lectures on agricultural chemistry."

From the notes of these lectures the Muck Manual was prepared. "The work," Dr. Dana states further, "was favorably received at home and abroad, where a considerable portion was reprinted. It has passed through several editions, each being enlarged by the addition of new matter, to keep pace with the times. To the present edition is added an entire new chapter on bones and superphosphates of lime and alkalies. . . .

"One word respecting the title of my book. It is my own. I have neither begged, borrowed, nor stolen it. That last has been done by an English author, who seems to be ashamed, not of the act, but of the name he has filched from me, and so eases his conscience by apologizing for his 'homely title.' I shall not discredit my child by being ashamed of his name. It was good at the christening, and I trust will be thought respectable in manhood."

This edition of the Manual consists of nine chapters. In the first three the author tells the origin and nature of the inorganic ingredients of soil, and in the fourth he describes similarly the organic constituents. Dr. Dana vigorously combats the idea that the kind of rock underlying a district has anything to do with the character of the soil in that district, showing that the soil at any place is a mixture of materials, most of which have been brought from a distance. His full explanations of the several topics that he takes up are summarized in brief statements in a conspicuous type, which he puts forth as the first, second, third, etc., principles of agricultural chemistry. Among these are, "Rocks do not affect the vegetation which covers them"; "Soils contain enough of all the mineral elements to grow any crop" (but it is otherwise with organic constituents); "One base may be substituted for another in an equivalent proportion."

After describing the mutual action of these two classes of substances, he takes up the subject of manure. His chapter opens characteristically:

"The true farmer, no less a sage than the ancient orator who gave to action the first, second, and third place in eloquence, will answer, if it is asked him what is his first requisite, Manure. What second? Manure. What third? Manure. These answers are to be united. Action and manure are the first and last requisites in agriculture; and in the attempt to show what is the last, and how it acts, will be offered every inducement to action."

In the seventy-five pages of this chapter he describes the action of the manures of all domestic animals, also poudrette and certain waste materials valuable as fertilizers—wool washings, soot, bones, and spent lye from soapworks—and gives the chemical composition of nearly all.

In a chapter on artificial manures and irrigation, he deals with the use of swamp muck or peat, and tells how to make it a first-class fertilizer by the addition of soda ash or potash. There are a few pages on the physical properties of soils, and then the use of bones as a fertilizer is discussed. An appendix contains the results obtained by Dr. Andrew Nichols and others with the methods suggested by Dr. Dana.

Dr. Dana's geological knowledge was kept bright and increased by constant additions from the best and latest authorities. It aided him greatly in his agricultural researches. One of his courteous attentions to scientific visitors was an excursion to a traveling sand, in an outlying part of the city of Lowell, which was slowly and steadily advancing over arable land, converting it into a desert place. His long-sustained and minute observations threw strong light on the formation of sedimentary rock deposits, where currents of air rather than currents of water were the active agent, and made this field his own.

Dr. Dana died at his residence in Lowell, March 11, 1868, in consequence of a fall upon the ice at his own doorstep. In person he was tall and slender, with blue eyes, dark-brown hair, and a fair complexion. The expression of his countenance was intellectual and sympathetic. He was extremely witty, and, in his hours of relaxation from study, he entered with great zest into the pleasures of society, contributing his full share to the enjoyment of others. Even in his scientific writings his humor had some scope, and added a charm and zest to his descriptions that made them highly enjoyable and utterly inimitable.

Dr. Dana's first wife died in 1828 and he afterward married her sister, Miss Augusta Willard. James Jackson, the only son of Dr. Dana who survived childhood, when arrived at a suitable age received a commission in the United States army, and was afterward promoted to the rank of brigadier general. Dr. Dana also left three daughters.

THE question of the Asiatic origin or derivation of the Mexican and Central American monuments was recently presented to the Anthropological Institute of Great Britain and Ireland by Mr. Osbert H. Howarth. The speaker had become strongly of the opinion, after several years' observations of the works, that they were traceable to an Asiatic source, and he suggested that no subject in the whole range of antiquity is better worth careful study than the possible tracing of this splendid decorative art of Central America through the various countries of Asia with a view of determining whether or not any features of it could be positively identified with those which were known to exist in the earliest dynasties of Egypt. The probabilities that this was the fact were much stronger to his mind than any probability that the work arose from an independent source.

Correspondence.

OCCUPATIONS, PRIVILEGES, AND DUTIES OF WOMAN.

Editor Popular Science Monthly:

SIR: In consideration of the great interest I felt in an able article in your magazine for May, entitled Political Rights and Duties of Woman, I venture to express some of the thoughts which stirred me upon its perusal.

As I understood them, the writer's objections to the principle of woman suffrage can be classed under three general heads: objections as to the advisability or possibility of certain *occupations* for women; objections on the plea of the *privileges* which they already enjoy; and objections based on the idea of any change in the *character* of woman, as wife or mother.

It is to me a matter of surprise, as it must be to many, that the question of occupation should be considered as having any bearing whatsoever upon the subject. Although irrelevant, in a consideration of it, we must own the magnitude of the subject, as viewed not only in regard to woman but to all human kind. What class can take upon itself the responsibility of dictating to any other class what occupation it is or is not fitted to enter upon? It is easily seen that such a course would inevitably clip the wings of progress, as it is a tenet of its movement that the fittest survive, and the unusually gifted of one generation become in some degree the type of the next. Of one thing we may be sure, that no one performs tasks for which he is incapable, and those succeed who possess the faculties necessary to success. A majority of the walks of life have already been thrown open to women, so that the question of a new occupation opened for them by the right of ballot, narrows itself down to the one of officeseeking and officeholding. We on both sides of the question own, of course, that not all women will desire to enter upon this work, or to take advantage of their political rights, with any more alacrity than do a large share of men. There is one thing of which I may be permitted to feel sure, that if any woman succeeds in wresting office from a masculine candidate, or even in time reaches the White House, it will be by means of abilities which no one can gainsay, for, rather than that votes will be given her because she is a woman, the likelihood will be that she will wrest them from prejudice and conservatism in spite of that fact.

Every year is further proving that sex does not extend to intellect, and those who still hold to that belief will in the course of time have to blind their eyes to a great many facts in order to cherish it. The *grande passion* stirs men as well as women, and has power to inspire or weaken in the same degree.

Women are a privileged class, the paper says. It is true that few of us have any remembrance but of kindness and love from father, husband, and brother, and that very many of us have no great wrongs to bring to light, no troubles for which to claim redress. But it is hardly a privilege we enjoy to be loved, but rather mere justice, for do we not love also, and are we not in the same degree kind? These privileges, if we may call them so, which we mutually enjoy, I hardly think can be weakened by the ballot or by anything less than a sudden change and upheaval in the heart of the universe itself. It is a privilege, we read, that women enjoy in being "exempted from the perils, wounds, and deaths incident to war"; that the ballot now takes the place of the more savage conflict of war, and in this conflict, as in the other, women are exempt. You can't exempt women from fighting; five out of six fight. They fight, as does man, the forces of Nature, time, flesh, and the devil. Woman is in the thick of the world's conflict, whatever and wherever her arena, as are all human creatures, struggling with that friction which is progress, with those forces with which processes of evolution polish the stone for the workman, the soul for its soaring. The potter binds her soul to his wheel, as yours is bound, and what she desires is the same freedom, the same room for her wings.

Certainly, now that the conflict has been removed from the open field of war to the more peaceful one of the ballot, the old and earliest valid reason for dictating to her—her minimum of physical strength—has been removed. In no way of life, except in those old, savage, hand-to-hand struggles, is the race invariably to the physically strongest. Do the athletes, the prize fighters, bestow a privilege upon weaker men when they refrain from knocking them down? The necessary requisite, after all, is not brute strength, but *health.*

The question of character is a very large one, and moved by far too mysterious and wonderful forces to be decided by the ballot. It may be that many men are mistaken in their idea that the qualities of gentleness, amiability, obedience, or a small range of thought, make women better wives and mothers than human beings who are capable of justice, breadth of view, strength of judgment, and wide sympathies and interests.

Though we please men and men please us, if we keep pace, it will be rather through our higher qualities of mind, character, and heart, than by our lower nature, weaknesses, and faults; but, Heaven knows, both men and women will ever have a sufficient amount of the latter.

One word more. An often-quoted picture is this: The husband, the wage-earner, from morning until night busied with cares and labors, which leave him little time for culture or the more refining pleasures of life, while the wife and daughters are kept in idleness at home, entertaining themselves with gay or frivolous pastimes, expending the income which was earned at such cost. Would it not be better for custom to break its bonds a little and look about it, and allow those idle women occupation that would assist the father and develop their own dormant faculties? Would the sympathy in that home not be of a deeper and more enduring sort?

For women to be idle is no better than for men, and this waste of life and time, which so many are guilty of, at the cost of some overworked man, is a condition of things which cries to Heaven.

GRACE A. LUCE.

PREVENTING THE SPREAD OF DISEASE.

Editor Popular Science Monthly:

SIR: In the short article on Individual Communion Cups (Popular Science Monthly, July, 1896, page 425) it seemed to me that a good word has been spoken in season on a subject where, in the opinion of many Christian people who have been blessed with a scientific education, a pressing reform seems necessary.

The subject is one which attracted my attention some time ago in a serious way, and a knowledge of the danger incurred by communicants on several occasions made me realize the urgent necessity of a change in the custom prevailing in Protestant churches. In one of the instances referred to the officiating clergyman was known to be suffering from cancer of the mouth in an advanced stage; yet this circumstance did not deter him from partaking of the sacramental wine before passing the cup to the other communicants present.

In the Presbyterian and allied churches where the elements are received by the congregation while seated in the pews, the plan adopted by the Rev. Dr. Charles Herr appears to me admirable; but in the Episcopal Church, where the communicants advance to the altar, the best arrangement would be that each member should bring with him a flattened cup of silver or aluminum, with an appropriate design or inscription upon it, which could be fitted into a leather cover and carried in the pocket or attached to the case containing the prayer book, etc.

As the Founder of Christianity declared that his mission in this world was "not to destroy men's lives, but to save them," and as that is the noble aim toward which science also is working, I can but hope that the medical men who are interested in the welfare of the congregations to which they personally belong will feel it their duty to draw the attention of pastors and people very earnestly to this much-needed reform, and that the pastors themselves will lose no time in following the excellent example of the Rev. Dr. Charles Herr, of the First Presbyterian Church, Jersey City.

I am, with regard, faithfully yours,

JULIA F. CARVILL LEWIS.

HOTEL LANG, HEIDELBERG, *July* 10, 1896.

Editor's Table.

A BISHOP ON PROFESSOR HUXLEY.

IN many minds it is a settled conviction that the attitude of the Christian clergy toward science must necessarily be one of antagonism. There has been much, of course, in the history of the past to give countenance to such a view, and possibly the recent publication of President Andrew D. White's able and interesting volumes on The Warfare of Science with Theology may just now be doing something to strengthen and extend the impression. President White, however, it should be remembered, has not failed to make it clear that, in the general progress of intelligence, the clergy are more and more being led to take up a reasonable position in regard to the teachings of science; so that, on the whole, the antagonism of which he writes may be looked upon almost as a thing of the past.

It is a pleasure to find evidences of this in contemporary happenings. Some weeks ago a meeting was called in the town of Leeds, in England, to consider the question of raising subscriptions in aid of the Huxley Memorial Fund. Among those present was the Bishop of Ripon, Dr. Boyd Carpenter, who spoke strongly in support of the object of the meeting. He did not profess to share all Huxley's opinions; but that did not seem to him any reason why he should not bear testimony to the nobility of Huxley's life and the value of his services in the cause of science and of popular enlightenment. He recognized in Huxley a great man—"great by virtue of his devotion to science, great by virtue of that wide appreciativeness he brought to bear upon it, and great in the power of expounding it to others." He acknowledged that there were those—though, as he said, a diminishing number—who were disposed to "look askance at the progress of science." Their feeling was that science threatened to take away their faith—a faith that was bound up with their dearest hopes; but men were now "beginning to understand that it can not be in the nature of things that facts and truths will contradict those things that are nearest and dearest and most essential to their happiness." This perception, this conviction, the bishop holds to be faith in its highest form. "Because we are men," he says, "we claim it to be our privilege and our responsibility to follow truth wherever it leads us. It is *not* our duty to encourage a timidity which, if it were encouraged, could only lead to a fatal obscurantism. The progress of knowledge can only deepen and intensify our attachment to the things which are true, and the things which are true can not be out of harmony with the things around us."

These are brave and noble words, but the bishop was determined to be yet more precise, so that no one could misunderstand his meaning. He therefore continued: "Religious truth, in one sense, must always wait on scientific truth; and religious truth must often change its form at the bidding and on the information given it by scientific truth. I am not aware that in the history of scientific progress religion has ever lost; the precious jewels have always been restored to her in richer and nobler settings. Because I believe that the advancement of knowledge must be for the benefit of mankind, and could not in the long run be hostile to any of the things most precious to us, I stand here to-day to do honor to one who labored in the cause of the advancement of knowledge, and did so much to make it the heritage of all people."

Finally, this representative prelate bore testimony to Huxley's "truthfulness of character," for which he said he had "the profoundest admiration." As to Huxley's antagonism to Christianity, he said it was far more called out by the "unfortunate attitude of some who made themselves champions of Christianity, than by anything in the essential nature of the Christian religion." Huxley was not a man who would have wished to deprive any one of convictions that were a source to him of moral strength and comfort.

So far the Bishop of Ripon; and if a bishop can say these things, what is there to hinder that perfect reconciliation of science and religion which will give to both the best conditions for development? The fault to-day—so far as fault there is—is not wholly on the religious side. On that side we see the timidity which the bishop deprecates, and for himself repudiates; but on the other side

we see at times a disposition to exult in the scientific view of things as being fatal to all hopes and aspirations which do not rest on facts as material as those of physiology or mechanics. Man, however, has never yet confined himself to the circle of his material wants and satisfactions, nor is there any evidence that he is going to do so in the future. Individuals may choose to grovel, but the race, we may be sure, will, through all vicissitudes, strive after the highest life that is possible for it, and will not be turned away from its ideals simply because there are some who say that they do not know what an ideal is. The mission of science is a great and glorious one—far greater and more glorious than some who claim to speak for it have any conception of—but it has no mission, and no legitimate function, which would divorce it from the higher life of man or place it in antagonism to his deepest instincts and intuitions.

LORD KELVIN'S "FAILURE."

VERY needless, in our opinion, was the confession of failure which formed so prominent a feature in the speech delivered by Lord Kelvin (Sir William Thompson) on the occasion of the jubilee celebration tendered to him at the University of Glasgow in the month of June last. The eminent professor's words were as follows: "I might perhaps rightly feel pride in knowing that the University and city of Glasgow have conferred on me the great honor of holding this jubilee. . . . I do feel profoundly grateful. But when I think how infinitely little is all that I have done I can not feel pride; I only see the great kindness of my scientific comrades, and of all my friends, in crediting me for so much. One word characterizes the most strenuous of the efforts for the advancement of science that I have made during fifty-five years; that word is failure. I know no more of electric and magnetic force, or of the relation between ether, electricity, and ponderable matter, or of chemical affinity, than I knew and tried to teach to my students of natural philosophy fifty years ago in my first session as professor. Something of sadness must come of failure, but . . . what splendid compensations for philosophical failures we have had in the admirable discoveries by observation and experiment on the properties of matter, and in the exquisitely beneficent applications of science to the use of mankind with which these fifty years have so abounded!"

Now, with all respect and deference to one of the very greatest scientific men of the century, we venture to affirm that Lord Kelvin here strikes a false note; we even go so far as to say that he indulges in false sentiment. If the labors of his life had been specifically devoted to finding out the essential nature of electric and magnetic force, at divining some ultimate mystery of Nature, we could understand his speaking of "failure" in the way he does; but seeing that nothing is more certain than that no such aim or ambition was present to his mind, but that his efforts were devoted to just those "discoveries by observation and experiment on the properties of matter" and those "applications of science to the use of mankind," in which he acknowledges the last fifty years to have been most fruitful; and considering that his distinguished success in that field of labor is recognized by the whole world, and was the cause and justification of the gathering held in his honor, we must say that the word "failure" in connection with such a career seems to us singularly out of place. One of his brother *savants*, Prof. A. Gray,

speaks of this "humble confession" as "characteristic of the man," but we do not find this view of the matter satisfactory. The question is a simple one. In what does scientific success or failure consist? Either word should have its own distinct meaning. If Lord Kelvin is to be counted among those who have failed, whom shall we put down as having succeeded? Sir Isaac Newton? But Sir Isaac Newton did not "penetrate the mystery of the constitution of matter," to use Prof. Gray's expression, any more than Lord Kelvin has done. He provided a formula which expressed one kind of action exerted by bodies on one another, but he gave no clew to the nature of gravitation. He worked out a great number of intricate questions in mathematical astronomy, but none of his solutions do more than correlate phenomena. We may admit him to have been a greater genius than Lord Kelvin; but that would not justify us in saying that the labors of the latter bore the stamp of failure. Each was successful in a high degree in what constitutes the true work of the scientific investigator, the reduction of phenomena to law: if either aimed at doing more than this he failed, but the failure was not a scientific one; it was the inevitable failure of the human mind in striving to transcend the region of cause and effect and the relation of subject and object.

We have only to consider for a moment in order to see and feel that so long as any one phenomenon or condition is recognized as the *cause* of any other, the secret of the universe has not been penetrated—we are as much in the presence of "mystery" as if we had a thousand or a thousand thousand separate causes to deal with. Our minds are so constituted that, while our whole consciousness depends on the recognition of difference, we have a constant craving for unification; we would fain, as it were, destroy that by which we live. It is the baffled desire for unification that gives us the sense of mystery; and when Lord Kelvin talks of "failure" he means no more than that he has not succeeded in merging effects into causes and causes into effects, and making a unity in which thought itself would disappear.

We think ourselves that the word is unfortunately used; for there are those who are on the watch to catch every confession or expression of weakness on the part of science. "The foremost physicist of the age," these will say, "confesses that all his labors of fifty years may be summed up in the one word 'failure'; that he knows no more to-day about the deeper questions of science than he did fifty years ago. Is it not plain that the Mosaic account of creation must be correct in all its details, and that men in general can not do better than submit themselves to ecclesiastical authority?" Perhaps the deductions may not be expressed in this broad and simple way; but such at least will be the drift of the argument. And yet the truth is that science is all the time doing all that it can reasonably be expected to do—revealing the order and relations of phenomena, detecting, by means of approved appliances, operations of Nature which had eluded previous observation and which must ever have eluded the unaided senses of man, opening wider and wider regions to human thought, and conferring upon mankind an ever-increasing mastery of the laws and resources of the physical world. It does all this by the aid of symbolical language and working hypotheses—in other words, by a kind of algebra of its own; and the utmost fault its critics can find with it is

that it can not in some way express the absolute reality of things without the use of symbols or formulæ. Well, science must share that reproach with the human intellect of which it is the product and manifestation; but we do not see why the reproach should be brought against it by its own most shining representatives. Rather might Lord Kelvin have said: "Science in my day has been most prolific of blessing to mankind; it is proceeding apace with its appointed task of enabling men to understand *for practical purposes* the world in which they live, and what shall be the limit to its achievements in that direction no one can foretell. As to the 'riddle of the universe,' of which we sometimes hear, that lies beyond its ken: only when thought ceases to be conditioned will that riddle—not be read, but—disappear."

Scientific Literature.

SPECIAL BOOKS.

Prof. Giddings's *Principles of Sociology* * is a very opportune book. A disposition has been manifesting itself for several years to call almost everything sociology. Most of the popular journals now have a department of sociology, into which they put everything going on in society that does not clearly belong to party politics. All the "advanced" social questions are being discussed under the head of sociology. Especially are so classed the zealous utterances of a large group of well-meaning persons who believe something ought to be done for the less favored members of society. In this class are great numbers of warm-hearted clergymen who think they see in the teachings of the Master a warrant for preaching wholesale social reforms, and this they call "Christian sociology." Add to this the thousand problems of charity, philanthropy, and general social betterment of the condition of the poor, and we have already in the infancy even of the word *sociology* a burden of unscientific and half charlatanic applications of it that threaten to sink it as deeply into obloquy and contempt as a similar procedure sunk that etymologically far better word, *phrenology*, half a century ago.

Of course, Mr. Herbert Spencer's great work, now happily completed, on the Principles of Sociology, not to speak of his Descriptive Sociology, and his other works on that subject, would have sufficed to save it from such a fate, but as it is in America that the tendencies above pointed out are most pronounced, so there was needed in America a standard work that should teach, so far as known, what sociology is, and serve in some degree to stem the tide of degeneration. Prof. Giddings's book to a considerable extent supplies this need. Those who, in the main justly, complain that it ignores all questions of social progress, that it treats wholly of what *is*, and not at all of what *ought to be*, should not forget the peculiar conditions under which it was written, as briefly described above. Whether Prof.

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* The Principles of Sociology. By Franklin Henry Giddings, M. A., Professor of Sociology in Columbia University. Pp. xvi + 476, 8vo. New York and London: Macmillan & Co. Price, $3.

Giddings believes in the possibility of a dynamic science of society or not, he was fully justified, in view of the circumstances, in confining himself strictly, as he has done, to the statical and historical aspects of sociology. Moreover, there was the less need of departing from this line, as there is in this country a school of dynamic sociologists, no more sanguine than he of immediate reforms, but working along the lines of social mechanics, to whom that aspect of the question may properly be left.

In view of this very youth of the science, and especially of the confusion of ideas as to what sociology means, it will be profitable at the outset to examine Prof. Giddings's definitions. The first is given on pages 5 and 6, where he says: "It is not too much to claim that we have now, at length, a sociology, which may be defined as the systematic description and explanation of society viewed as a whole. It is the general science of social phenomena." He recognizes, however, that social phenomena are chiefly distinguished from all other classes by the psychic element that enters into them, and on page 25 he rather sententiously remarks that "psychology is the science of the association of ideas. Sociology is the science of the association of minds." This he qualifies on the next page in the following form: "Psychology thus is the science of the elements and of the genesis of mental phenomena, as determined by physical and organic relations. Sociology is the science of mental phenomena in their higher complications and reactions, and of the constructive evolution of a social medium, through which the adaptations of life and its environment become reciprocal."

One of the most difficult questions has been to distinguish sociology as a science from what have been called the "special social sciences"—i. e., the several groups of phenomena obviously social, which, whatever sociology may be, must stand in some intimate relation to it. On this Prof. Giddings, pages 30, 31, makes the following observations:

"Clear thinking and a discriminating use of terms will create order from the confusion and will establish sociology in its rightful place, where it can no longer encroach on the territory of other sciences or be crowded out of the field by them. Sociology is a general social science, but a general science is not necessarily a group of sciences. No doubt the word will continue to be used as a short term for the social sciences taken collectively. . . . By methods of sound logic, and with guidance from the history of other sciences, sociology can be definitely marked off from the special social sciences." And on page 33 he adds: "Therefore, while sociology in the broadest sense of the word is the comprehensive science of society, coextensive with the entire field of the special social sciences, in a narrower sense and for purposes of university study and of general exposition it may be defined as the science of social elements and first principles."

Finally, on page 419, he gives the following definition:

"Sociology is an interpretation of social phenomena in terms of psychical, organic adjustment, natural selection, and the conservation of energy. . . . It is strictly an explanatory science, fortifying induction by deduction, and referring effects to veritable causes."

Although these various definitions are somewhat bewildering if not inconsistent, they do nevertheless afford some idea of what sociology is, and it is clear that they give no countenance to the practice of making it a general receptacle for all sorts of reform programmes and theories of social re-

generation. In fact, with Prof. Giddings, as with Spencer, sociology is the study of society as it is and as it has been; also, perhaps, so far as a knowledge of its laws render prediction possible, as it is likely to be in the future; but not at all a study of what it ought to be, much less an attempt to lay down rules for its improvement.

Although Prof. Giddings has followed Spencer very closely in his general ideas of sociology, still he thinks he has discovered one very fundamental principle that is entirely new, and upon which he attempts to build the entire science. This principle he calls the "consciousness of kind"—i. e., the fact that men recognize their like, and that this natural affinity makes it possible for them to crystallize into social groups. Of course, he finds the principle running down through the entire animal series, and he commits the fallacy of regarding this as the highest proof of its sociological importance. In fact, he has seized upon a well-known and important biological principle, and, as may be done with so many others, he has successfully applied it in various departments of social life. It has doubtless helped him in dealing with the difficult question of the origin of human association, to which he has given special attention.

The work is divided into four books, the first of which deals with the theory, the second with the structure, the third with the evolution, and the fourth with the causes of society. Space will only permit a brief reference to Book III, on the Historical Evolution of Society, which is not only the most important department of the work, but is the most ably treated. The general subdivision was briefly outlined in an earlier paper on the Theory of Sociology. It is into zoögenic, anthropogenic, ethnogenic, and demogenic association, to each of which a chapter is devoted. The treatment of zoögenic association is too brief, but if properly expanded it would form an important introduction. To the two chapters on anthropogenic and ethnogenic association too great praise can not be bestowed. Although somewhat trite subjects after all that has been written by Tylor, Spencer, Morgan, McLennan, and the rest, Prof. Giddings has succeeded in so organizing, methodizing, and condensing this immense mass of data as to render it not merely interesting and instructive, but even fascinating, and to enable the reader to acquire in small compass practically all of importance that is contained in so many large volumes.

The chapter on Demogenic Association, which in a work on sociology should have been the *pièce de résistance*, is less ably written and should have been expanded and improved. But the reader will see for himself what its defects are, and will be able to a great extent to supply them. This department of the work, however, taken as a whole, possesses exceptional merit.

It will be charitable to the author to refrain from discussing Book IV, on Social Process, Law, and Cause. Much of it is an attempt to apply Spencer's First Principles to social phenomena, in which the author is generally unsuccessful. There are, however, some very good suggestions under the head of Social Choices, which we can commend to the reader.

Mr. *Schoenhof's* latest contribution to the Questions of the Day Series deals with the economic subject that is uppermost in this country at present—namely, how far prices can be raised by an abundance of cheap cur-

rency.* There are few important effects that do not flow from mixed causes, and Mr. Schoenhof makes it plain that the fixing of prices for commodities is no exception. Besides the condition of the currency he names wages, profit rates, expense of distribution, taxation, science and invention, interest, transportation, and monopolies as affecting prices. His views, as expressed in former writings, having been criticised severely, he has been led to examine for this volume the prices of the period anterior to the discovery of the American silver mines and to carry the comparison down to the present time. He is thereby confirmed in the opinion that the *quantity* of money in circulation has little influence on prices, but that its *quality* is more important. Further, "that price increase brought about by the issue of depreciated currency or other inflating causes has always acted detrimentally to the interests of the working classes." In the early chapters he gives statistics of the output of gold and silver from the mines of the world from 1492 to 1894, and the value ratios of gold to silver at various times, showing that the latter were not affected by the relative quantities of the two metals in existence. He maintains that silver has become cheapened because it has been left behind as a money metal by advancing civilization. The main part of the volume consists of a history of prices in England, France, and Germany from the middle ages to the present time, combined with which there is considerable history of European currency. Following this are four chapters in which the influence of what the author regards as the true price-making factors is set forth in some detail. Mr. Schoenhof is an expert in economic research, and his positions are all supported by statistics and historical facts.

GENERAL NOTICES.

We venture to say that no writer has made the Alps more attractive to thoughtful persons than Prof. *Tyndall* has. His evident enjoyment of the physical and mental exhilaration afforded by scaling the icy peaks, his full appreciation of the beauties of the mountains, of which his trained observation enabled him to see more than the mere tourist, and the simplicity and vividness of his style of writing combine to give the accounts of his climbs the fascination of tales of adventure. His *Glaciers of the Alps* † was first published in 1860, and for many years past has been out of print. It is divided into two parts: the first, chiefly narrative, describes his ascents and traverses of the mountains in 1856–'59, which included two ascents of Mont Blanc, two of Monte Rosa, one of the Finsteraarhorn, a winter expedition to the Mer de Glace, and many minor climbs; the second, chiefly scientific, contains his observations on the Alpine ice and his discussions of the glacial theories current when they were made. In the narrative part the human element is delightfully conspicuous. Profs. Huxley and Ramsay were his companions in some expeditions, and to the reader who knows both them and the author only as prominent English scientists it is supremely comic to read of Tyndall being buried in hay by his guide for a night's rest in the loft of a cheese-maker's cowhouse, or of Huxley lighting and holding wax matches one after another to furnish light for the others to get an early breakfast by. These experiences, too, are not without their spice of danger, and the author makes it plain that the rocks and ice are not to be trifled with.

The second part of the book is introduced by three chapters explaining the nature of light and heat, after which the phenomena of ice exhibited in glaciers are discussed at

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* A History of Money and Prices. By J. Schoenhof. Pp. 352, 12mo. New York and London: G. P. Putnam's Sons. Price, $1.50.

† The Glaciers of the Alps. By John Tyndall. Pp. 445, 12mo. London, New York, and Bombay: Longmans, Green & Co. Price, 10*s*. 6*d*.; $2.50.

length. This discussion contains much interesting matter bearing upon the history of glacial theory, the subject at the time Tyndall wrote being in heated controversy. In order that the pages now reproduced might contain nothing touching the views of others which Prof. Tyndall might have wished at the present time to alter or omit, his widow submitted the historical parts to Lord Kelvin, who assures her that, in his opinion, "the statements on controversial points in this beautiful and interesting book of your husband's are all thoroughly courteous and considerate of feelings, and have been felt to be so by those whose views were contested or criticised in them." The beginning of Tyndall's study of glaciers proceeded from a discourse on slaty cleavage which he delivered at the Royal Institution, in June, 1856. This discourse is appended to the volume. Some sixty simple illustrations aid in making clear the text.

Dr. *H. Holbrook Curtis's* work on *Voice Building and Tone Placing** relates to the singing voice. The author has invented a method of tone exercises for overcoming serious affections of the vocal cords which has been used satisfactorily by the most renowned singers, and he furnishes here an exposition of the physiological principles, and the elementary laws of sound and music, on which it is based. The chapters on anatomy and respiration are intended to be of value to the physician as well as to the student of singing; and for that reason also the subject of the vibration of the vocal cords has been considered in a way in which it is not entered into in any other work. The author's theory that the overtones introduced by the proper method of placing tones in the facial resonators induce a new plan of vibration of the vocal cords has recently been verified by the investigations of Prof. Oertel, of Munich, and several of his experiments have been introduced to explain the true plan of vibration of the cords as seen in the stroboscope. The author has also tried, with the aid of these experiments, to elucidate his theory as to the removal of "singers' nodules" by tone exercises in a scientific way. The general scheme of the building of the voice, in accordance with the author's theory of tone placing, is appended for the benefit of teachers and students. The book is the result of a vast experience with singers. The ideas have been put together in a concise and simple way, without any attempt at elaboration of style. The closing chapter, on Voice Figures, in which the vibrations are translated into pictures of great variety and beauty, has more than a physiological or acoustic interest. It is a revelation of the grace and æsthetic charm with which Nature's processes are found to be invested, whenever we are able to recognize them.

In his discussion of the *Primary Factors of Organic Evolution*,* Prof. *Cope* attempts to select from the mass of facts accumulated by biologists those which, in his opinion, throw a clear light on the problem of organic evolution. As the actual lines of descent can be finally demonstrated chiefly from paleontological research, a large part of his evidence is drawn from that source. Another reason for preferring the paleontological evidence is that Darwin and his school have drawn their evidence from œcology and Weismann and writers of his type from embryology, leaving the paleontological field less worked. The mass of facts recently brought to light in the field of paleontology, especially in the United States, remained to be presented, and the evidence they contain to be interwoven with that derived from the sources mentioned. The view is accepted, to which many zoölogists are now inclined, that the factors of evolution which were first clearly formulated by Lamarck are really such; and the research has proceeded on the assumption that every variation in the characteristics of organic beings, however slight, has a direct efficient cause. Any theory of evolution which omits the explanation of the causes of variations, Prof. Cope holds, is faulty at the basis. Hence the theory of selection can not answer the question asked, although it embraces an important factor in evolution. The subject is considered under the several headings of

* Voice Building and Tone Placing. By H. Holbrook Curtis, M. D. Pp. 215, 12mo. New York: D. Appleton & Co. Price, $2.

* The Primary Factors of Organic Evolution. By E. D. Cope, Ph. D. Pp. 547, 12mo. Chicago: Open Court Publishing Company. Price, $2.

The Nature of Variation, The Causes of Variation (including Natural Selection), and The Inheritance of Variation, with chapters on The Energy of Evolution, The Function of Consciousness, and The Opinions of Neo-Lamarckians.

In view of the recent successful trial of Prof. Langley's flying machine and the encouraging results obtained by Lilienthal in Germany, the *Aëronautical Annual** for 1896 is of especial interest. It consists of a number of disconnected papers, from men prominent in aëronautical matters, on the various aspects of the subject. The first article is one by Otto Lilienthal, entitled Practical Experiments for the Development of Human Flight, in which he describes his recent experiments and pictures the apparatus. The editor has an article on Wheeling and Flying, in which he calls attention to the analogy between the slow development of the two methods of locomotion. A long paper by Hiram S. Maxim on Natural and Artificial Flight, which is said to be made up of abstracts from an unpublished work, and to contain the results of Mr. Maxim's latest thought, comes next. An article by Octave Chanute, on Sailing Flight, is prefaced by a short biographical sketch and portrait of the author. This is followed by a three-page contribution on How a Bird Soars, by Prof. W. H. Pickering, in which a mechanical explanation of this apparent paradox is offered. There are a number of other interesting papers, several of which are on Kites and Kite-flying, and a short bibliography of aëronautics. Good illustrations are quite numerous.

The last of the Technological Handbooks to reach us is No. 10, *Gas Manufacture*, by *J. Hornby*. It is intended as a student's manual, and was especially arranged with reference to the examinations of the city and guilds of London (England) Institute. The author opens the book with a brief consideration of the various kinds of coal and their value for gas-making purposes. The following chapters and the main portion of the book treat of the technical processes and the special apparatus used in manufacturing, purifying, and testing the gas. The final chapters are devoted to special topics, such as the laying of mains and surface pipes, the construction of gas meters, gas burners, and the composition of coal gas (London: George Bell & Sons, 5*s.*; New York: Macmillan & Co., $1.50).

Concrete Geometry for beginners, by *A. R. Hornbrook*, is an introduction to the study of geometry by means of object lessons. The author very truly says that the "universal demand of the learning mind is for the concrete and the particular as stepping stones to the abstract and the general." He has found in the course of his teaching that a student might be able to recite glibly demonstration after demonstration of geometric principles and still be totally at a loss when asked to make simple applications of them, this condition being evidently due to the inability of the student to picture the physical quantities on which he was working. The text consists of an apparently carefully selected and graded series of simple problems for fixing in the beginner's mind the elementary facts of geometry from lines and angles to squares and cubes. After each two or three chapters there is a "cumulative review" for testing the student's grasp of the new principles and combinations (American Book Company, 75 cents).

The *Home Study Review*, published by the Home Study Association at Ann Arbor, Mich. (15 cents; $1.25 per annum), is designed to offer to those who can not attend a school or college an opportunity of pursuing studies at home under direction. The first course is to include the following subjects: History, German, biology, rhetoric, English literature, and a commercial course. While it is to be hoped that the publication may prove useful, the scheme does not seem promising.

The *Transactions of the American Microscopical Society* for 1895, Volume XVII, contains the usual number of valuable papers, which are, however, most of them so technical as to have little interest except for the biologist or microscopist. Among the few papers of general interest is one by Simon Henry Gage, the president, on The Processes of Life revealed by the Microscope: A Plea for Physiological Histology,

* The Aëronautical Annual, 1896, No. 2. Edited by James Means. Pp. 158, 800. Boston: W. B. Clarke & Co.; London: William Wesley & Son. Price, $1.

in which he strongly urges that in studying an organism or its tissues the investigator to gain certain knowledge must know the age, health, state of nervous, muscular, and digestive activity; in fact, all that it is possible to find out about the processes of life that are going on and have gone on when the study is made.

The *Thirteenth Annual Report of the New York State Agricultural Experiment Station* contains, as do all these publications, the results of much valuable experimental work. Among the papers of especial interest in the present volume may be mentioned the following: The Individuality of the Cow as influencing Offspring; The Relation of Sex in Thoroughbred Calves; Proximate Constituents of the Dry Matter of Food; The Relation of Fat in Food to Fat in Milk, and Twin Calves; Alfalfa Forage for Milch Cows; and A Detailed Comparison of the Different Breeds of Dairy Cows with reference to the Production of Cream and Butter.

The second number in the Section of History and Economics of the Leland Stanford Junior publications consists of a monograph on the *Official Relations between the United States and the Sioux Indians*, by *Lucy E. Textor*. The author begins her history with the formation of the republic, and traces in detail the various forms of legislation and "agencies" by which we have attempted to regulate and protect the Indians. The work seems carefully done, and, as the editor says, each special investigation of this sort is important as an advance toward that "general ideal history of the United States" which we still lack.

School Interests and Duties, developed from Page's Mutual Duties of Parents and Teachers, from various Public Reports and Documents, and from the Bulletins of the National Bureau of Education, by *Robert M. King* (American Book Company, $1), is connected with Mr. Page's address by the address having been a powerful agent in the advancement of the schools to their present position, and having partly laid the foundations of that advance. In the meantime new factors have come into prominence in school affairs — chiefly the institution of school boards, directors, trustees, etc., to take the place of citizens at large in the direct management of the schools; and further, the vast extension of the subjects to be dealt with. This book has been prepared with a view to bringing down to date the doctrine of co-operation in school interests, "with all that it implies of enlightened, harmonious, and effective work in the interests of popular education," and the thoughts of numerous recent writers are quoted in connection with the discussion. It deals with such subjects as the duties of parents, of teachers, and of school officers, school architecture, hygiene, libraries, morals, etiquette, celebrations and observances, the use of the dictionary, the teachers' institute, reading circles, and the teacher's relation to public opinion. In conclusion, a series of outlines of reading-circle work is given.

The advantages of vertical penmanship have been so widely recognized that every publisher of writing-books now has to have a vertical series. A vertical style of the well-known Spencerian penmanship has been prepared, and in the *Shorter Course* this style is presented in seven small square books. Directions with cuts showing positions are given on the inside pages of the cover. (American Book Company, 6 cents each.)

The distinguishing features of a new elementary text-book on *Algebra*, by *Lyman Hall*, are stated in the preface as, first, preserving the familiar methods of arithmetic as far as possible in the first chapters, in order to convince the student that algebra is merely an extension of the mathematical knowledge he already possesses; second, review examples and questions throughout the book which will help him to master following chapters and prepare him to pass from this to a higher treatise without a formal review. (American Book Company, $1.)

In his recent text-book on *American Literature*, Prof. *Brander Matthews* makes fifteen authors of the United States stand out prominently by giving each a chapter and providing them a background of colonial and other writers whose works are of less general interest. Portraits of most of the authors mentioned are given, together with pictures of the birthplace, and sometimes of the later residence, of the more prominent, and facsimiles of their manuscript. Each

chapter is followed by references for reading and a few suggestive questions, while at the end of the book is a chronology of American literature down to 1896. (American Book Company, $1.)

Under the title *The Glory of the Garden*, a collection of odes and sonnets has been printed by *William V. Byars*, with an appended essay on The Horatian Ode and the Tuscan Sonnet. The recent discovery—or rather recovery—which Mr. Byars claims to have made, of the principle of melody governing the verse of the great classical poets from Homer to Horace and Virgil was due to a partial recovery of the accent of the classical languages, effected through a comparison of the sounds of modern Greek and Italian with ancient Greek and Latin. A modern Greek, a graduate of the High School at Athens, was employed to read Homer aloud, for comparison with the Tuscan of Dante read aloud by an educated Italian. The verse of Béranger read aloud by a Frenchman was also compared with the lyrics of Horace, but it was to the comparison of the melody of Dante with the rhythm of Homer, when read by its accents, that the recovery of classical accent is chiefly due. When classical verse was read with an accent rather lower than that of modern French, and with the downward value of the grave accent equal to the upward value of the acute, the surprising discovery was made that in both Horace and Homer the melody of the verse depended on the systematic use of rhyme—not of regular end rhyme as in modern verse, but of line and staff rhyme, regulated by a method not unlike that used by the old Norse poets. The discovery of Bentley, that the verse of Virgil and Horace is read by "synaphea," without regard to its verse endings, is thus shown to be of the highest importance.

Vol. I, No. 1, of the *A. I. C. P. Notes*, which interpreted means American Association for Improving the Condition of the Poor, has recently reached us. Its space is all given to an account of the utilization of vacant city lots for the purpose of giving the unemployed an opportunity for earning their own living. During recent years several attempts of a similar nature have been made, some of them being attended with considerable success, notably the Detroit vacant city lot farms, which were inaugurated by Mayor Pingree. The attempt in New York is fully described in the above pamphlet, and, while it has not thus far been a remarkable success, still its officers are very enthusiastic and hopeful for the future. Subscriptions are requested. (105 East Twenty-second Street, New York city.)

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Baginsky, Dr. A., Fruhwald, Dr. F., and Monti, Dr. A. Archiv für Kinderheilkunde (Archives of Pædiatrics), Vol. XX, Nos. 3 and 4. Stuttgart: Ferdinand Enke. Pp. 160.

Bardeen, C. W. A Manual of Common School Law. Syracuse: C. W. Bardeen. Pp. 290. $1.

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Fragments of Science.

X Rays in Surgery.—Considerable advance has been made during the past few months in the application of the X ray to surgical diagnosis, and it seems fairly certain now that the trunk with its contents, as well as the extremities, may be examined by the use of this agent. A recent article in the American Journal of the Medical Sciences, by W. W. Keen, includes some remarkably clear reproductions of X-ray pictures, one of which shows very beautifully all the bones of the trunk. Among much interesting matter the article contains a suggestion which deserves at least a trial. The difficulty with the present pictures is that an exposure which is long enough to show the bones blots out all detail in the soft parts. Dr. Keen suggests the use of a number of superposed paper films. The X rays will act almost equally on them all, and by withdrawing one at a time at short intervals a series of pictures of the object will be obtained which should show all the required detail. An important improvement in the Röntgen apparatus is said to have been made by the General Electrical Company of

Berlin, by means of which the interior of the head and chest may be directly examined by means of the fluorescent screen, even the action of the heart and lungs being discernible. A demonstration was recently given by Dr. Oscar Levy at the Lancet offices, and was reported as very successful. The vacuum tube employed contained two concave electrodes, midway between which was situated a platinum disk in a plane of 45°. One or other of the electrodes, according to which gives the best results, is connected up, by means of a wire, to this disk, the wires of the coil being attached to the concave electrodes, so that the anode is duplicated. The screen employed measured about ten by eighteen inches, and consisted of small crystals of platinocyanide of barium.

The Present Business Depression.—An article in the July Engineering Magazine, by Edward Atkinson, attributes the present business depression to the Bland and Sherman acts, "under which the demand debt of the United States was increased by an issue of notes or promises to pay by nearly five hundred million dollars for the purchase of silver bullion, which, when coined into dollars at 16 to 1, is bad money. We may easily trace the cause of our present bad conditions to the enforced use of bad money." He presents the conditions under the free coinage of silver in a somewhat new light, and makes it obvious that, instead of giving the poor man an undue advantage, it will increase the opportunities of the rich, and instead of benefiting the United States it will place her at a disadvantage and make her mints common dumping ground for all the depreciated silver of the world. He says: "The advocates of the free coinage of silver dollars of full legal tender propose to enable the bankers of Europe to gather in the silver bullion of the world, of which the market value is now sixty-eight cents per ounce, to send it to our mints to be coined without charge, and then to force it upon our farmers, wage-earners, and other persons at $1.29½ an ounce, thus cheating them out of about half their dues for the benefit of two privileged classes—the silver miners of the West and the foreign bankers and their agents of the East." This tendency on the part of politicians to attempt by legislation to counter the result of natural forces is always eventually quite futile, and, as in the present case, is usually fruitful of much suffering and anxiety in the business world. The secondary place which silver now occupies as a money metal is entirely a natural growth due to causes over which statesmen and governments have no control, and the United States, even if she succeeds in legalizing an unlimited coinage of fifty-cent silver dollars, will simply, by purely artificial means, be substituting an unnatural, unwieldy, and limited silver unit of value for the compact, convenient, and widely used gold unit. Not only would the resulting currency be much less satisfactory than our present one, but the change from one to the other would almost surely involve serious business troubles.

The Expert Witness.—Considerable attention is being given by the more thoughtful newspapers and some scientific journals to the disreputable episodes which almost invariably occur when experts are called on for testimony before the courts. The present custom, which permits each side to call in its own expert and pay him for his testimony, is calculated to produce anything but *expert* testimony, unless the term expert applies to manipulation of facts to suit his client's case. It would be about as conducive to justice if each side were allowed to retain and pay a judge and jury of its own. In fact, the practice is so obviously calculated to defeat instead of aid the ends of justice that it is difficult to see how it ever originated. The mere fact that a witness is employed and paid by the defendant or plaintiff unconsciously enrolls him on that side, and there are few experts whose testimony is not modified by such an arrangement. This custom has led so often to a flat contradiction regarding facts between opposing authorities that the general public has lost confidence in such testimony. This is, of course, very unfortunate, as it is beyond question that a man who has devoted his life to a study, for instance, of poisons and their effects on the body, is in a better position to judge of the probabilities in a given case than the ordinary layman or physician. Under a system where the expert is called by the court no question of bias could be

raised, and science would not be disgraced from time to time by those who are willing to trade on their scientific reputation.

The Competition Fetich in Education.—"The dying out of the distinguished school of naturalists which this country once produced, and which culminated in Darwin, is a fact which scarcely admits of dispute," says W. T. Thiselton-Dyer in a recent article in Nature. "English naturalists of the generation which is now passing away have belonged to two groups. Some have been born to wealth, some to poverty. Class prejudice was against the one, means of livelihood against the other. The richer disciples of our art seem now to have gone irretrievably and to have no successors. The poorer have changed their tone. They tend to treat science as a career like the civil service." Mr. Thiselton-Dyer quotes a friend who believes the cause of this degeneration in the ideals of scientific workers to be due to the system of constant competitive trials, which it seems, in England as well as in the United States, pervades everything in the schools from Greek to athletics, and which completely overshadows the real reason and point for going to school. "This remarkable system begins, the masters of this and other schools told me, at about eight years old. There is no time to learn, to think, or observe. The boys must beat some other school in tennis or football, or must beat some one else in the history of the Punic wars. . . . The great object of education appears to be to have every boy competing for something absolutely useless to him in later life." This latter, of course, is something of an overstatement; but the indiscriminate encouragement of rivalry and subsidizing of the winner, without reference to the value of the knowledge which the success implies, has been steadily at work in our universities for some years, and has been one of the principal factors in bringing the college graduate into disrepute as an unpractical and many times really ignorant man. He quite loses his bearings when launched forth on the actual sea of life, judges questions from the limited standpoint of the local horizon which his *alma mater* has provided for him, and, worst of all, being a college graduate, is rather inclined to be supercilious at any suggestion that perhaps there are a few small scraps of knowledge which he is not yet master of. There have, however, quite recently been signs of reaction against the competitive system—at any rate, in athletics—and it is to be earnestly hoped that this reaction will extend itself to the whole curriculum. We may then, perhaps, expect to see an educational system based on the requirements of everyday life, and the graduates of our highest educational institutions taking their full share in the business and politics of the country.

A Natural Botanical Garden.—A somewhat curiously distributed flora is described as existing in the island of Sakhalin, at the northernmost end of the Japanese group. Its geological structure resembles that of Siberia much more nearly than that of Japan. Volcanoes, which are such a characteristic feature of Japan, are entirely wanting here, and the three parallel chains of mountains which form the backbone of the island are composed of Jurassic slate, Cretaceous strata, and Tertiary limestone, being similar in formation to those of Siberia. The mountains reach an average elevation of six thousand to seven thousand feet, and this, combined with the abnormal climatic conditions of the island, give rise to a very varied vegetable life. Although it lies between the latitudes of Trieste and Hamburg, its conditions of life are almost polar. Bathed by two cold marine currents, it is exposed without protection in winter to the cold northwest winds of the east Siberian anticyclone, and an abnormally cold winter as well as summer results. At sea level snow lies in open sunny spots even in May. Snowfalls occur to the end of May. Owing to the cold currents which surround the island, distance from the coast plays an important part in determining vegetable growth, and gives rise to anomalies perhaps observable in no other portion of the earth's surface. In Siberia and in central Europe it has many times been noticed that during the winter cold the mountain summits are much warmer than the plains. The same is true in Sakhalin. The cold and heavy winter's air collects in the lower regions, while above the mountain heights enjoy the warmer sea breeze. But even in summer, owing to the cold ocean

currents, the mountains display abnormal temperature conditions; and while an arctic vegetation prevails on the seashore, forests with subtropical Japanese species occur at a certain elevation, and only on the highest summits does the forest again give place to arctic plants. The principal trees of the forest are pines, firs, and Siberian larches. The growth is very rapid and the struggle for existence severe, so that many trees are killed; the dead trees still standing and others fallen are so numerous as to make these forests almost impassable. On the west side of the island maples, birches, and large numbers of mountain ashes abound. At a certain height, especially in the more interior portions of the island, quite a sudden change to subtropical trees occurs. High bushes of Japanese *Ilex crenata*, stems of bamboo as high as a man, bush-like *vaccinium*, fine hydrangeas, and the colossal leaves of *Araliaceæ* and *Petasites* make their appearance, and form an almost Indian jungle beneath the conifers of the far north. On the highest summits the forest disappears and is replaced by dwarf firs, *Cembra pumila*, and evergreen stretches of *Empetrum nigrum*. Where the seashore is flat and exposed to the wind trees are entirely wanting, and an approximation to the arctic tundras prevails. The true tundra region, however, is not on the seashore, but in the great longitudinal valleys, where a regular polar tundra, with frozen soil, peat bogs, and arctic vegetation, occurs. The banks of the streams are, however, clothed with luxuriant vegetation. At a distance of a quarter to a half mile from the river bank the peat bog gives place to a charming meadow of *calamagrostis* grasses, with park-like groups of birches, poplars, willows, etc., and an exuberant bush vegetation.

Do the Poor hate the Rich?—An interesting discussion is going on in the Contemporary Review between Mr. Hobson and Mr. W. H. Mallock, as to whether the poor hate the rich. Mr. Hobson affirms it and Mr. Mallock denies it. An impression that they do prevails largely among certain classes of philanthropists and socialists. The London Spectator, reviewing the discussion, thinks that, however it may be in the continental countries of Europe, this is not the case in England and among Americans of English descent. The immense majority of these accept differences in pecuniary conditions as part of the order of things, and rather approve them as affording incentives for ambition and grounds for hope. They do not hate the rich, because they would all like to be rich, and hope by some means some day to become so. They rather regard them as sources of benefit to the community, as persons who will keep up the standard of living, and who increase the general mass of opportunities. They will welcome the settling of a wealthy man among them, because he will spend money. Those may hate the rich who have been disappointed, or who have lost the hope of joining their number, but few others. "Have the multitude, whether in England or the United States, ever tried to limit wealth, or divide wealth, or confiscate wealth at death, or in any way whatever endeavored to cause wealth to cease to be? They have examples of such legislation before them all over the continent, but they not only do not carry similar measures, but they never ask for them, and would treat any candidate who relied upon them in his programme as either a mere faddist or an advocate of novel and disagreeable social heresies. . . . The truth is that both here and in America discontent, when it exists—and of course there is plenty of it—takes the self-pitying direction, and not the direction of envy. We remember, about five years ago, being much struck with the form taken by the discontent of a raging orator in one of the parks. He was boiling over with fury against the rich, and at last, rising to the height of his argument, he burst out into an apostrophe: 'You rich fellers, you have funds, you have bonds, you have railway shares: tell me, you wretches, why we should not have them too?' That, not the stripping of the rich, was the English rough's genuine and most hearty aspiration."

The Ways of Sparrows.—The habits of the London sparrow have been studied with much advantage by a writer in the London Spectator, who finds more method in the ways of the bird than we are usually apt to imagine. The site of the sparrows' nests is chosen with much care, and always with a view to avoiding the dangers from cats.

Hollows in the perpendicular wall faces of the building are preferred, but any proximity to the roof, where cats are liable to abound, is shunned. The nooks furnished in old houses advertised for sale or demolition, by the frames which are set upon them for bill posting, are much resorted to by the birds. The spaces between the frames and the walls are commodious nesting places. The under concavities of corrugated iron roofing furnish hundreds of ready-made tunnels under the cross beams, and when one of these roofs is built in a neighborhood, the sparrows will desert their old, now less attractive quarters "to a bird." "No cat can climb it or stretch a claw far enough up to hook out the nest." The London sparrow is intensely local. "He moves as seldom as he can from his own particular block of houses or square or terrace; and in the suburbs he keeps not only to his own house, but often to the back or front of the house only, not caring to circumnavigate his own suburban garden. In spring, when pulling crocus flowers to pieces becomes a mania with sparrows for a few days, it has been noticed that in many instances all the sparrows in the front of the house will take a fit of crocus-spoiling, while the flowers behind the house are let alone. Or the reverse may be the case, all those behind the house being spoiled, while the sparrows haunting the front of the house and front garden are occupied in some other sphere of activity. If an old nesting place is destroyed, the local birds at once seek another as close as possible to it."

Camphor.—Owing to the widespread use of camphor in the arts and in medicine, its increasing scarcity and expensiveness have raised the problem of artificial cultivation. There are a number of trees, many of them widely separated in genus, order, or species, from which camphor is obtained. The tree, however, which produces most of the camphor of commerce is the *Cinnamomum camphora*, a member of the laurel family, belonging to the same genus as the cinnamon tree. This tree attains enormous size. The bulk of the camphor imported into Europe comes from Japan and Formosa, and a small amount from China, although the trees are very abundant in the latter country, and the wood is much used. Every part of the tree is said to be useful, even the fruit being employed in the preparation of tallow. The statement that the large use of smokeless powder is responsible for the high price of camphor is denied by Sir Frederick Abel, who says that, while camphor was much used in the manufacture of smokeless powder in the early days, it was soon shown to have serious practical disadvantages, and its use has been to a large extent discontinued. It is, however, used for the conversion of collodion cotton into celluloid, and, in combination with various ill-smelling compounds, is the basis of most moth powders. In a recently published account of the commercial and scientific value of this tree Dr. E. Grassmann urges the importance of increasing the plantations to the greatest possible extent, and the placing of some restriction on the wanton destruction of the trees.

Evolution of the Storage Battery.—A recent article in the Journal of the Franklin Institute, by Maurice Barnett, on the Evolution of the Storage Battery, gives many interesting historical data. It seems that in 1801 Gauterot, while decomposing salt water electrolytically, noticed that on breaking the circuit he could obtain a current of short duration from the electrodes. A few years later Ritter constructed a pile consisting of disks of copper, separated by pads moistened with saline solution; after passing a strong current through this pile he was able to obtain a current of considerable intensity from the pile itself. This was practically the first storage battery. In 1859 Gaston Planté began a series of researches which led him finally to the elaboration of a practical storage battery. He electrolyzed diluted sulphuric acid with rods of the various metals used successively as electrodes. Lead gave the most promising results, not only on account of its capacity, but also because of the intensity of the discharge. Planté came to the conclusion, in 1859, that lead was the only useful metal, and then proceeded to construct his spiral accumulator, which consisted of two plates placed concentric with each other in dilute sulphuric acid, one plate being lead, the surface of which was peroxidized, the other, metallic lead. He got from this electric couple an E. M. F. of

about two volts. Having constructed his accumulator, Planté experimented with various methods of "forming" the plates that they might yield effects extending over a considerable interval of time. His method was to pass a current through the accumulator first in one direction, then in the other, and repeat this reversal many times with intervals of rest in between. The only current available for this work was that obtainable from a primary battery; this made the process a long and expensive one, but by its means currents of considerable density, lasting for a length of time depending on the extent to which the plates had been affected by the electrolytic process, were obtained. Between 1859 (when Planté began his experiments) and 1880, when Faure invented the pasted battery, great changes had taken place in the condition of the electrical arts and manufactures. The dynamo had been perfected, and offered means for the cheap production of currents of great density and high E. M. F., and hence gave a new stimulus to the production of a practical storage battery. Faure made pastes of red lead and litharge, which he applied to the surfaces of the positive and negative plates. When these were subjected to the forming process, the red lead was oxidized to peroxide and the litharge reduced to spongy lead, with a material saving in time and cost over the Planté process. Almost immediately accumulators were put to a variety of industrial uses, among which may be mentioned their application to carry the day load in lighting stations and to prevent the necessity for running dynamos at night in private residences. Even for traction purposes, where accumulators are subjected to the severest demands, their use was proposed as far back as 1880, and in 1883 a car went into service at Kew Bridge, London, equipped with a Siemens dynamo, set to run as a motor, and about four thousand pounds of batteries. The first storage battery put upon the market was, of course, crude, and the result was that in nearly all of its various applications it was a failure. The modern storage battery dates from the invention of Faure in 1880, and up to within a few years the pasted lead battery was the only form used to any extent. Recently the Planté type has again come into favor, together with an improved form of battery known as the chloride accumulator. The characteristics of the Planté type of battery are capability of giving heavy discharges without sustaining injury, minimum local action, and general freedom from the irregularities due to local action. The chloride battery takes its name from the fact that the active material of the plates is made from lead chloride rather than from metallic lead, as in the Planté, or lead oxide as in the pasted batteries. These cells show a high efficiency in practice, small deterioration, capability of holding a charge over considerable intervals of time, and freedom from short-circuiting, buckling, sulphating, or any of the troubles to which the old lead batteries were subject. They are thus seen to possess none of the defects of pasted batteries, while they embody all the merits of the Planté cells, without their faults of structural weakness and tedious formation. To-day the extension and use of the storage battery are looked on with growing favor.

Relations of Moisture and Vegetation.—M. Edmond Gain has found, in special researches on the subject, that the influence of moisture on vegetation varies at different periods of growth of the plant, and that alternations of moisture and comparative dryness are more advantageous to it than constant moisture. The plants that require constant moisture as a factor of their most vigorous growth are relatively few. Nearly all plants need water in order to secure vigor of growth, but require it at different intervals in certain precise stages of their vegetation; and plants which at one time take up water with advantage may suffer much from an equal supply at another time. As a rule, the need of water is urgent when the first leaves are appearing. It then diminishes till just before blossoming, when a large supply is called for. This should be suspended after the flowering season is over, for the fruit is best perfected in a relatively dry medium. If the plants blossom more than once, they need a new supply of water previous to the second flowering. In all the author's experiments those plants which were watered at the two critical seasons of first growth and the beginning of blossoming did as well as those which were constantly wa-

tered. M. Gain further found that moisture in the soil favors and increases the number of fruits and seeds, while a dry soil promotes larger and heavier seeds. Plants in dry soil have more roots than those in wet soil. While the tenure of moisture has little influence on the number of tubers, they are larger and heavier in a moist soil; yet they are less perfect than tubers grown under relatively dry conditions. Thus, while greater moisture is favorable to a larger immediate return, it is less promotive of perfection in the reproductive parts, and so favors the individual rather than the vigor of the species.

Geography in the Middle Ages.—The first number of Herr M. Konrad Miller's work on the Oldest Maps of the World is devoted to the map of the universe of St. Beatus, a Spanish theologian, who died A. D. 798. It was made in connection with the author's Commentary on the Apocalypse, to point out the regions assigned to the several apostles, and exists in many copies of different ages, the maps in which differ but little from one another. One of the most famous of these copies is the one called the Manuscript of St. Sever, in the Bibliothèque Nationale, Paris, of about A. D. 1050. The map includes the whole world in an oval inclosed by a blue sea border containing large and fierce-looking fishes and red objects which might be taken for red slugs, but which are really vessels. At the extreme east (north and south being at the ends of the axis of the oval) Temptation is represented in a naturalistic style. At the point where the earthly paradise was supposed to exist, Adam is bashfully making symbolical gestures, and Eve, bold and full of initiative, is picking the apple, both entirely naked. It appears clear as the light of the sun that all the wrong is on Eve's side. In the extreme west are Tangier and Cordova at the entrance of a sea that washes Majorca and Minorca, then Sardinia, Corsica, Cyprus, and Crete, and turns to the north in the Adriatic Gulf and the Hellespont. The Fortunate Islands, in the midst of numerous fishes, are Madeira and the Canaries, and, together with the British Isles and perhaps Iceland, mark the western limit of the world. In the south the Red Sea, bright scarlet, is separated from the Mediterranean by the whole of Egypt and Palestine in a way to defy the most enterprising isthmus-borers. No pains are taken to give the contours of the coasts, the bays, or the gulfs. Spain is reduced to a triangle, one side of which, curved, is formed by the Pyrenees, as if they were a fringe, while the other two sides are the shore, straight. The details of the geography of the several countries are curious, but can not be described here. Many strange things appear in Africa, too, while the origin of the Nile in a great lake is indicated in the clearest manner.

Origin of Honeydew.—M. Gaston Bonnier's studies of the formation of honeydew have led him to the conclusion that not only is it elaborated through the agency of aphides, but it is also exuded directly, under proper conditions, by the leaves of the trees. He has observed that under conditions of a considerable difference between the temperatures of the day and the night, when no insects can be found, a sugary liquid falls after sunset in drops from certain trees; and after wiping the leaf with absorbent paper, he found the minute droplets issuing from the stomata. This was observed on the epiceas, silver-firs, Scotch pines, Austrian pines, oaks, maples, aspens, poplars, alders, birches, vines, and various herbaceous plants. Yet the aphides are the more frequent cause of the production of honeydew. Their work is done mostly in the daytime and is suspended during the night, while the direct production of honeydew takes place at night and ceases in the daytime. It is promoted by the interposition of cool nights between hot and dry days, and is favored by increase in hygrometric conditions and darkness. The exudation can be provoked artificially by dipping the branches into water and then placing them in the dark in a saturated atmosphere. Under these conditions the leaves may be caused to produce honeydew when those on the trees from which they were taken do not. Although bees will go to collect any sweet substance when they can get no better, they always prefer the best they can find. When mellifluous plants are blooming abundantly, they pass the honeydew by; but when mellifluous flowers are scarce, they gather honeydew. The chemical composition of honeydew is various; but that naturally exuded approaches that of the honey

of the nectaries more closely than does that elaborated by aphides.

Horse Racing in Bosnia.—The Bosnians are very fond of horse racing. Their meetings were kept up for five hundred years under the native laws, and are supported with still more splendor by the Austrian Government. The horse is the favorite companion of the native, who celebrates it in his songs, and cares for it as he would for a child, guarding it against the evil eye and malice. The Bosnian mountain horse possesses fine qualities, and is sober, agile, and hardy. Previous to being put in a race he is subjected to a very curious special training. For three or four weeks he is enveloped in thick coverings, and is bled repeatedly and thoroughly. He is walked all day, and especially in the evening and the morning, in the open air. No hay is given him, and as little as possible of barley and water. His legs are massaged time and again, and rubbed with a mixture of water, salt, and two yolks of eggs. He is given only a few hours of rest, and the treatment is kept up till the very moment of the race.

M. Daubrée.—By the death of M. Daubrée French geology has lost one of its most brilliant workers. Born at Metz on June 25, 1814, he soon developed a special interest in minerals. He passed in 1834 from the École Polytechnique into the *Corps des mines*. He already, while a student, began to display that breadth of view and width of sympathy which distinguished his later career. Gradually his attention was more and more directed to the experimental side of his favorite science. He studied the artificial production of various minerals, and entered upon a course of profound investigation in which he became the great leader, and did more than any other observer to advance that department of the science. The difficult problems of metamorphism had a peculiar fascination for him, and he devoted himself with admirable patience to the task of trying to solve some of them by actual experiment. The various researches collected in his Études synthetiques de Géologie experimentale have taken their place among the classics of modern science. He also devoted much time to the study of meteorites. His last important volumes discussed in detail the phenomena of underground water, and traced the various solutions and changes which water is now producing and has formerly effected within the crust of the earth. M. Daubrée spent the greater part of his scientific life in Paris, where he occupied official posts in the École des Mines and Muséum d'Histoire naturelle. He retired from office two or three years ago, but still continued to interest himself actively in scientific research. He was one of the most regular attendants of the Académie des Sciences, and one of the most influential members of that distinguished body, serving on many committees and taking an active part in all its concerns. He began to be somewhat ailing before last Easter, and, though for a time he appeared to rally and hopes were entertained that his life might still be prolonged, he died peacefully at his house in the Boulevard Saint-Germain on May 29th.

Cacao Cultivation in Mexico.—The cacao tree is a native of Mexico, and long before the conquest the Aztecs used the cacao bean in making a beverage which they called *chocolatl.* "All nations subjugated under the Aztec eagle had to bring, among other valuables, a certain number of bags of cacao to the palace in the great Tenochtitla as an annual tribute to the emperor. It was so highly prized among the ancient natives that in trade it was utilized as currency among the lower classes. The varieties cultivated were quauhcahuatl, mecacahuatl, zochicucahuatl, and tlacacahuatl." The tree grows wild and in cultivation in the States of Colima, Michoacan, Guerrero, Oaxaca, Chiapas, Tabasco, and central and southern Vera Cruz, where the elevation is from a hundred to twelve hundred feet above sea level. Chiapas and Tabasco, however, contain the most favorable climate and soil for the cacao tree, and the finest cacao in the world is grown in these two States. The species most cultivated in Mexico are cacao or *Theobroma ovalifolia*, *T. bicolor*, and *T. angustifolia.* A warm, moist climate, having a mean temperature between 76° and 77° F., is necessary for its most successful cultivation. The best elevation is from three to five hundred

feet, but the tree will not thrive if exposed to the direct influence of the sea breeze. The plants are propagated by means of the seed, which is simply covered with loam and some sort of fertilizer, and then the whole covered with banana leaves. The bed is sprinkled every day for twelve or fifteen days, when the seedlings appear. Then the banana leaves are removed, and sheds are erected over the bed, which serve as shade and shelter. A year after sowing, seedlings are about twenty inches high and ready for transplanting. The plants begin to yield remuneratively in about five years. The average annual yield of dry cacao from each tree varies greatly, but is somewhere between a pound and a half and eight pounds. The pods having been gathered are placed in heaps under the trees, to be subsequently taken to the *quelradero* where they are broken. The kernels or nibs are then taken out of the pods, which are either opened with a machete or a knife made from a wood called jahuate. The seeds are thrown into wooden troughs called *tollas* half filled with water to wash them, and the beans are then carried away to the cacao house for the sweating or fermentation process. After being properly sweated they are dried ready for shipment. It is stated that seven hundred and fifty trees will give the planter a net annual profit of more than $1,225.

MINOR PARAGRAPHS.

Prof. Dewar, in the first of a series of lectures on Chemical Progress at the Royal Institution, paid a well-deserved tribute to the pioneer work of M. Moissan, in his researches on the combination of carbon and the various metals in the electric furnace. Prof. Dewar also called attention to the fact that many years ago Mendeleef put forth the view that the immense localization of petroleum at Baku and other centers could only be accounted for on the theory that it was being continuously generated by the action of water on carbides. Benzene, which is the nucleus of all the colors hitherto obtained from coal-tar products, is reached by the acetylene process in three stages: first, the combination of lime and coal in the electric furnace; second, the decomposition of the resulting carbide by water; and, thirdly, the transformation into benzene of acetylene gas by means of heat.

The catalogue of earthquakes in Russia, to which are added those in China, Persia, and other countries bordering on that empire, begun by A. Orloff, in 1869, and just completed and revised by Prof. Mushketoff, contains a list of about 2,400 separate earthquakes which occurred in 560 places, between 596 B. C. and A. D. 1887. Of them, 710 took place in China, 549 in East Siberia, 36 in West Siberia, 202 in Central Asia, 590 in Caucasia, 121 in Asia Minor and North Persia, and 188 in European Russia. Considering only the periods during which the observations went on without interruption, the frequency of earthquakes may be represented as having been 640 in each hundred years in Caucasia, 310 in China, 290 in East Siberia and Turkistan, 138 in Middle and South Russia, and only 19 in North Russia, Finland, and the Baltic provinces. The date of the catalogue shows that while in Siberia and Central Asia earthquakes are more frequent during the autumn and winter than during spring and summer, the proportion is reversed for China and Caucasia.

The interdependence of the most unlike things in Nature is well shown by the following: It seems that in certain districts the growing of water cresses is quite an important industry. The caddis worm is very fond of water cresses, but is usually kept from doing them any serious damage by the trout, which it seems are very fond of the caddis. But during last season a large number of herons appeared, who have a special predilection for trout, which they thinned out to such a degree that the caddis worms were given a free course, and soon destroyed the water-cress crop. The loss of the water-cress grower was primarily due to ravages of the caddis worm; which ravages were due to the lack of trout; the lack of trout being due to the unusual number of herons present in the neighborhood, and the unusual number of herons was due to the men who encouraged their breeding and multiplication for other reasons. Thus we have a state of things

which at first sight seems to have arisen through purely natural causes, but which, upon closer inspection, is clearly traceable to man's interference with the "balance of Nature."

NOTES.

Some recent experiments, says Industries and Iron, seem to indicate that iron is much weakened after being pickled and galvanized. A dozen eyebolts, all precisely alike, so far as could be perceived by external inspection, were carefully selected; six of these were laid to one side and the others sent away to be galvanized. When the galvanized bolts were returned the whole twelve were put together and tested, when it was found that the galvanized bolts were the ones to break; not in any instance did the ungalvanized ones give way.

Although Spitzbergen has been frequently visited, its coasts have been well surveyed, and it has even been a place of industrial and commercial importance, no attempt has been made to explore the interior of the main island. Mr. W. M. Conway purposes to supply the omission, and to lead a scientific party during the summer, who will make a thorough study of the land. The west island is penetrated by many fiords, and no part of it is more than twenty-five miles from the sea. The party will cross from fiord to fiord, and will be supplied from a steamer which will meet them at appointed places.

As, in the rush of waves, the billows travel onward, the energy, Mr. Vaughan Cornish observes in Knowledge, is passed from point to point, silently and smoothly, till the leeward shore is reached. Here all is changed. On the one side is the swinging water, ever handing on the energy of its motion. On the other side is the dead resistance of the beach, to which each breaker as it falls yields up its store of energy. There is no finer display of natural forces than the rush of the waves on a rock-bound coast, when each billow as it nears the shore raises a steeper crest, and, dashing down in thunder on the rocks, throws upward and abroad a cloud of glittering spray, which falls in salt showers.

After the bicycle comes the *celerette*, a modified revival of the old *draisienne*. It is a machine without pedals, and can be made very cheaply, with a wooden frame and even with wooden wheels, to which India-rubber tires may be added if desired. It is propelled by kicking with the feet upon the ground, and the activity and vigor required to keep it agoing depend on the character of the road. On a smooth, level road the work is light, and down hill the machine goes of itself. The advantage it offers is that of getting over the ground more rapidly and with less fatigue than by walking; but it is not likely to compete seriously with the bicycle.

The smoke of a common wood fire has been found by M. G. Palozzi to be a very efficacious disinfectant, capable of destroying pathogenic germs suspended in the air or attached to walls and furniture, or hidden in drapery or clothing. The author recommends it as a convenient and very economical means of disinfecting sick-rooms or any other contaminated places.

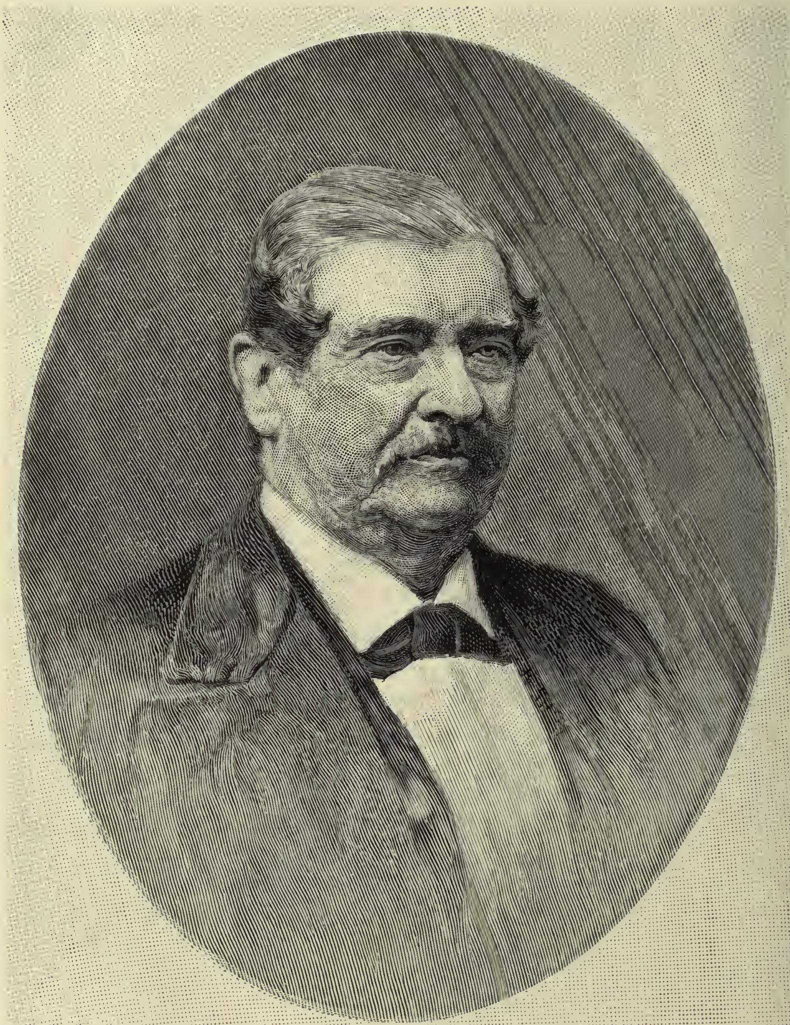
The Portuguese Government has decided to celebrate the four hundredth anniversary of the discovery of the route to the East Indies by way of the Cape of Good Hope, which was made by Vasco da Gama, July 8, 1497. It is understood that exhibitions and scientific congresses at Lisbon will form part of the proceedings.

At last Darwin's suggestion that the boring of a coral reef is the wise way to settle its mode of formation is to be carried out. Prof. Sollas is in charge of an expedition which started last May from Sydney, fully equipped for boring one thousand feet if necessary, for the island of Funafuti, one of the Fiji group. This island is a typical atoll; it is about fifteen miles in circumference. The lagoon has a good entrance, and provides firm anchorage. The results of the expedition should be of great importance.

The committee on public baths appointed by Mayor Strong recently submitted plans which provide for a bath house in Tompkins Square, and two smaller and subterranean lavatories—one under Main Street, and the other under Greeley Square, at the junction of Broadway and Sixth Avenue. These baths will be important agents in promoting public health, and have been sorely needed in New York city for years.

The preparations for the British Association meeting in Liverpool next September are now going on rapidly. The meeting promises to be a very interesting one. A number of the owners of works of manufacturing and engineering interest have offered to open their buildings for inspection during the week, and numerous enjoyable social events are promised.

Cavaliere Cristoforo Negri, whose death was recently announced, was a distinguished Italian scientist, and for many years a most enthusiastic promoter of geographical research. Born at Padua in 1809, he first devoted himself to the study of law; he held the post of Professor of Constitutional Law at Padua, but was after 1848 compelled to leave the city for political reasons. He was the founder, in 1866, and the first President of the Italian Geographical Society. He was for many years an honorary corresponding member of the English Royal Geographical Society.



ROBERT EMPIE ROGERS.

APPLETONS' POPULAR SCIENCE MONTHLY.

OCTOBER, 1896.

THE METRIC SYSTEM.

By Prof. T. C. MENDENHALL,
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IN the June number of this Journal there appeared a paper on the Metric System, by Herbert Spencer. It was originally published as a series of anonymous letters in the London Times, in the course of a discussion growing out of proposed legislation by the English Parliament. They aroused little interest among metrologists, except as examples of "curious and interesting reading," until their authorship was acknowledged by Spencer. No little astonishment was created by this announcement, and as a matter of fact, owing to the extraordinary character of the letters and the great fame and reputation of Mr. Spencer, the statement was not at first credited by many. Indeed, messages were sent to London, inquiring, "Who is this Herbert Spencer who is writing about the metric system?" These things are worth mentioning, to show the surprise everywhere manifested, not on account of the fact that Mr. Spencer was opposed to the adoption of the suggested reform in weights and measures, but rather at the singular arguments which he advanced in defense of his position. Without a single exception they had all been traversed more than a quarter of a century ago; their inherent weakness and entire lack of philosophic consistency had long ago been pointed out; and it is perfectly safe to say that, with possibly one exception, they are such as no one familiar with the progress of metrology during the past quarter of a century would think of offering at the present time, however strongly opposed to the metre and its derivatives he might be. The great influence which everywhere and always goes with the name of the distinguished

author of these letters, and this alone, compels those who are advocates of metrological reform to offer some reply to the propositions which he has advanced, and a brief analysis of them will now be undertaken, with the hope of showing that they are either fallacious or utterly inapplicable to the question under consideration.

As Mr. Spencer begins by declaring that the "advocates of the metric system allege that all opposition to it results from ignorant prejudice," which he very properly declares is far from true, it may be well to say that, in the opinion of the writer, there is relatively little of that sort of thing to contend with in the United States. What is far more dangerous as an obstacle to human progress, and often far more common, is what may be called "intelligent prejudice," meaning thereby an obstinate conservatism which makes people cling to what is or has been, merely because it is or has been, not being willing to take the trouble to do better, because already doing well, all the while knowing that doing better is not only the easier, but is more in harmony with existing conditions. Such conservatism is highly developed among English-speaking people on both sides of the Atlantic, and is likely to turn up in the most unexpected places. It is often a phase of ancestral or national pride, and finds its expression in the feeling that whatever pertains to one's own race or country is, on the whole, better than anything else of its kind. Those who are under its influence are adepts in finding ingenious reasons and excuses in defense of an attitude toward reform which they must know to be founded on neither logic nor fact. These people are numerous among opponents of reform in coinage, weights, and measures, and, as already noted, it is with this class that the most serious difficulty is encountered. "Ignorant prejudice" generally disappears when ignorance disappears, and fortunately in the present instance the system which it is proposed to substitute for that already in use is so extremely simple that it can be learned and understood in a few minutes, while certainly no one man has ever, in an entire lifetime, completely mastered the "customary weights and measures" in use in England and America.

It will be convenient to consider the objections offered by Mr. Spencer in the order in which he has presented them in the four separate letters which go to make up his article.

In the first he has reproduced in quotation a considerable part of the well-known argument of Sir John Herschel, written and widely published over thirty years ago. The inconsistency and utter worthlessness of this have been so long recognized that one has a curious feeling of fighting a straw man in attacking it at this time.

Sir John Herschel claimed, first, that the metre was not exactly the ten-millionth of the terrestrial meridian passing through France, which was entirely correct, and that, therefore, it was not a good unit for international use, which does not at all follow. He further attempted to show that the polar radius of the earth, which could never be known except indirectly, was a better unit than the quadrant, a large part of which could be measured directly, and that this radius differed by only eighty-two yards from 500,500,000 English inches. He then proposed to increase the English standard by its one-thousandth part, so as to furnish what he declared would then be "a system of linear measurement the purest and most ideally perfect imaginable." It has always been a surprise that so able a mathematician and astronomer could have overlooked the inherent weakness in such an argument. To those who have followed the history of this subject it is unnecessary to say that for many years no metrologist has thought for a moment of relating the standard of length *accurately* to any terrestrial dimension. The precision of our knowledge of the figure and dimensions of the earth, now and for many years to come, is such as to forbid this, even if there were no other arguments against it. In the light of current geodesy Sir John's calculations themselves furnish a curiously interesting proof of this. The argument with which he opposed the metre may to-day be turned with equal force against his proposed "ideally perfect" inch. According to the latest determination of the polar radius of the earth, his eighty-four yards become more than one thousand yards, and if his scheme had been adopted when proposed it would have been as badly "out of joint" with Nature as is the metre.

The simple facts are that while in the beginning the metre was made to be as nearly as possible one ten-millionth of the meridian, no one imagined that it could be exactly so, or rather that we could ever know that it was exactly so. It is sufficiently near that value to be very convenient in calculations relating to terrestrial distances and areas, but it must always be considered as defined by a *material standard,* and no metrologist ever thinks of it in any other sense. Within a few years Michelson has devised a method of measuring light waves with an accuracy hitherto unthought of, and has measured the length of several such waves in terms of the international prototype metre at Paris, so that we have the metre related to what we may assume to be an invariable dimension in Nature, with a degree of accuracy extremely satisfactory at the present time. But this does not alter the fact that it is and must be regarded as an arbitrary unit represented by a material prototype. Keeping this fact in mind, it will not be necessary to point out the total irrelevancy of Herschel's argument.

Something must be said, however, of the sentence which Mr. Spencer has quoted in which, referring to his proposed plan for relating units of length to units of weight and capacity, Herschel says, "And thus the change which would place our system of linear measure on a perfectly faultless basis would at the same time rescue our weights and measures of capacity from their present utter confusion."

It is usually considered to be hardly fair to pick a single sentence out of a group and quote it as representing the views of another; and *cutting a sentence in two in the middle, when the last half is against you,* is a practice so generally condemned that we are compelled to believe that Mr. Spencer must have accidentally fallen into it in this instance. Indeed, if full quotation had been made of what preceded this sentence and upon which it is founded, the one, rather meaningless, argument against us would have been changed to two very good points in our favor. Sir John suggested that the inch be increased by its one-thousandth part, so that it might be one five-hundred-millionth of the polar radius of the earth. He then undertook to show that by increasing the *grain* (by legislative enactment) by its one-eighteenth part, a cubic foot of water would weigh one thousand ounces, thus furnishing a decimal connection between the unit of weight and that of volume. This interesting scheme affords another illustration of the danger of patching up old and unsatisfactory systems, for a recent determination of the weight of a cubic inch of water by Mr. Chaney, in charge of the imperial standards in London, reveals the fact that the quantities on which Herschel based his calculations and suggestions were in error many times greater than was the metre, against which his arguments were directed. The complete sentence, of which Mr. Spencer quoted one half, as above, is as follows: "And thus the change which would place our system of linear measure on a perfectly faultless basis would at the same time rescue our weights and measures of capacity from their present utter confusion, *and secure that other advantage, second only in importance to the former, of connecting them decimally with that system* on a regular, intelligible, and easily remembered principle; and *that* by an alteration practically imperceptible in both cases, and interfering with no one of our usages or denominations." The words following "confusion" were omitted by Mr. Spencer, and they have been italicized to invite attention to their great significance as showing that the *decimalization* of the new system of weights and measures was earnestly sought for by Herschel. That Mr. Spencer is violently opposed to this can only with great reluctance be accepted as a reason for the abrupt termination of his quotation.

Before beginning the exposition of his own views he ventures

to quote another objector to the metric system in the person of Prof. H. A. Hazen, of the United States Weather Bureau, who some time ago argued that its adoption would necessarily include that of the centigrade thermometer scale, and that as, in his opinion, this was very bad, the metric system must be very bad. Among meteorologists and physicists this reference will be thought to be singularly unfortunate, and it furnishes a striking illustration, among the many to be found in the article under review, of Mr. Spencer's inability to recognize or properly estimate "values" in regions of thought to which, it must be admitted, he is comparatively a stranger. However much one might doubt the conclusions reached by Sir John Herschel, his splendid career as an astronomer and exponent of exact science commands the respect of all lovers of real learning. When we consider that, first, the centigrade thermometer scale has no more to do with the metric of weights and measures than with the coinage of the United States, and, second, its advantages over the unscientific and awkward scale of Fahrenheit are so many and so great that it is already well-nigh universally used, and almost absolutely so among scientific men of all races and nations, it is apparent that no time need be wasted in commenting upon a statement which, by its juxtaposition with that of Herschel, has already achieved a notoriety to which it has no claim either by reason of character or ancestry.

In his second letter Mr. Spencer's own arguments begin to be developed. He first objects to the metric system because, although it is a century old, it has not yet, even in France, entirely driven out some of the old denominations and units. In reply to this it may be said that little research is required to reveal innumerable examples of persistence in the use of words and things for more than a hundred years after their betters were available. On this point I will imitate Mr. Spencer by quoting from a letter recently received from a well-known man of science and admirer of our distinguished opponent. He writes: "This is amazing when coming from Spencer. He says on page 189, 'But one might have thought that after three generations daily use of the new system would have entailed entire disappearance of the old, had it been in all respects better.' Now Spencer knows better than any one else the persistency of habit in all people. A volume a foot thick might be written on the persistence of habit."

The next objection is worthy of more serious consideration, and it has been given (for it has long been discussed) a good deal of weight by many thoughtful people. It refers to the alleged universal tendency to continual bisection, thus leading to the use of halves, quarters, eighths, sixteenths, thirty-seconds, sixty-

fourths, and, sometimes in subdividing the inch, one-hundred-and-twenty-eighths. To begin with, the existence of any such inherent tendency is quite open to discussion, but, without going into that, it is at least plain that it has never shown itself in the evolution of systems of weight and measure. In evidence of this the following tables of English measures of length and weight may be cited, and, that there may be no mistake, they are drawn from a text-book on arithmetic written by one of the most distinguished of England's nineteenth-century mathematicians:

Length.		Weight.	
3 barleycorns are	1 inch.	$27\frac{11}{32}$ grains are	1 dram.
12 inches are	1 foot.	16 drams are	1 ounce.
3 feet are	1 yard.	16 ounces are	1 pound.
$5\frac{1}{2}$ yards are	1 pole.	28 pounds are	1 quarter.
40 poles, or 220 yards, are	1 furlong.	4 quarters are	1 hundredweight.
8 furlongs, or 1,760 yards, are	1 mile.	20 hundredweights are	1 ton.

These are far from being complete, for two or three additional tables are necessary to fully exhibit the units and ratios for both length and weight, and they are even more irregular in construction than those shown above. In all, as well as in the English money units and denominations, there is no indication whatever of this "natural tendency" toward continual halving. It *is* a common practice, possibly growing out of a tendency in some degree natural, to *continually bisect a single unit*, and this is likely to be the case under any system of weights and measures, and to it there can be no sort of objection. It is important, however, to note that this is in no way related to the question of desirable or convenient ratios of units, and that it has practically no weight whatever as a criticism of the metric system.

But even if this were not true, it would weigh vastly more against the systems in customary use in England and America than against the metric system. What possible objection can there be to speaking of a half or a quarter or an eighth of a mile or rod or yard or inch, if one wishes to do so? And no more can there be to a half, quarter, eighth, or sixteenth of a kilometre, kilogramme, metre, gramme, centimetre, millimetre, etc., nor, again, to the use of such fractional parts as thirds, fifths, or sevenths, if they seem to be desirable. But to compare the two systems in this respect one should undertake such a problem as finding the value of a third, quarter, fifth, or eighth of a mile or a ton in rods, yards, feet, and inches, or hundredweight, pounds, ounces, drams, and grains, and then do the same thing in the metric system. The enormous superiority of the latter will at once be revealed.

On the other hand, it can not be denied that there is, and has been for many years, a strong tendency toward the *decimal* sub-

division of single units, even among users of our own clumsy system of weights and measures.

In weight, for instance, we in the United States have long ago decided that a hundredweight shall be a hundred pounds, as its name implies, and not a hundred and twelve as in England, and our ton is almost universally two thousand pounds, although we still retain the traditional ton of twenty-two hundred and forty pounds in certain transactions; and as if to emphasize the utter absurdity of the thing, in some parts of New England a "long" or "gross" ton of coal weighs twenty-two hundred pounds. In many extensive calculations the avoirdupois pound is adopted as the only unit of weight, and fractional parts are expressed in tenths, hundredths, etc.; and this is found to reduce the labor of such calculations enormously. In length measure the tendency toward decimalization is still more marked. In land surveying and in engineering operations it is now the all but universal practice to use the foot as the unit and multiply and divide decimally. Even in the traditional "surveyor's chain," with its one hundred links, each being 7·92 inches in length, there was a serious attempt to secure some of the advantages of decimalization, but it is quite superseded now by the one-hundred-foot tape, with its divisions of ten feet each, and each foot divided into tenths, etc. In reference to the chain, a quotation from the book from which the tables given above are extracted, will not be without interest. After explaining that by a rather laborious process the following measures of surface may be derived:

144 square inches are			1 square foot,	
9	"	feet "	1 "	yard,
30¼	"	yards "	1 "	pole,
40	"	poles "	1 rood,	
4 roods are			1 acre,	

the author remarks: "Thus the acre contains forty-eight hundred and forty square yards, which is ten times a square of twenty-two yards in length and breadth. This twenty-two yards is the length which land-surveyors' chains are made to have, and the chain is divided into one hundred links, each 0·22 of a yard or 7·92 inches. An acre is, then, ten square chains. It may also be noticed that a square whose side is sixty-nine yards and four sevenths is nearly an acre, not exceeding it by a fifth of a square foot." This is a fair example of the beautiful simplicity of a system which all English-speaking people are assumed to understand and which many of them are reluctant to give up.

Again, in accurate machine-shop practice the use of decimal divisions is becoming almost universal. The unit is generally the inch, and it is subdivided into tenths, hundredths, thousandths, etc. "True to one hundredth, or one thousandth, or one ten-thou-

sandth of an inch" is heard a hundred times oftener in every shop than "correct within a sixty-fourth or a hundred and twenty-eighth, etc.," and it means not only greater convenience of expression and measurement, but an actually higher standard in precision of workmanship. To the objection, then, that the tendency of mankind is toward a binary rather than a decimal division of units, which is almost the only one offered by Mr. Spencer worthy of serious consideration, we may briefly reply by saying that even granting it to be a fact, it has no bearing whatever on the questions of *ratios* and *relations* of units, which is what distinguishes one system from another; that such a tendency may find expression in one system as well as another, and certainly with infinitely greater facility in the metric system than that now in use among English-speaking people; and, furthermore, that the estimation of fractional parts by tenths or hundredths is believed by many who habitually work that way to be both easier and more accurate than by halves, quarters, eighths, etc., and as a matter of fact the prevailing tendency is away from the latter and toward the former.

Mr. Spencer seems to have a painful satisfaction in the fact that in California the "bit" is still used, or was about twenty years ago—painful, because he feels obliged to characterize it as a "retrogression." As already said, it ought not to be necessary to remind him of the slow changes in human customs. Even in the time of John Quincy Adams the word "dime" (which began life as *disme*) was almost unknown and the coin itself very nearly so, for the shilling in all its multiplicity of forms and values still held place. Even now the shilling, bit, sixpence, "levy," etc., are not unknown in parts of the United States, but their presence serves only to emphasize the enormous superiority of our decimal system of coinage over that which, happily, our forefathers had the courage to throw off. He also expresses surprise that we have a quarter of a dollar, and that he does not see things advertised to sell for one dollar and three dimes or four dimes, etc.

He has here unconsciously called attention to one of the most important features of a decimal system—that, in fact, upon which its great superiority depends—namely, the ease with which changes from one denomination to another are made, and the consequent almost universal reference to a single unit. Some comment on the English money system in respect to this feature will be made later, but in illustration of this remark it may be said that nobody who understands the money system of the United States ever thinks of expressing any given amount in eagles, dollars, dimes, cents, and mills, but in dollars only. Everybody, however, can instantly convert any expressed amount into any one or all of these. Compare, for instance, $432·873 and £85 7*s.* 8¾*d.*,

and consider the memory and labor demanded to convert the former to eagles, cents, or mills, or the latter to pounds, shillings, pence, or farthings. Our eagles, half eagles, quarter eagles, half dollars, quarters, dimes, five-cent, three-cent, two-cent, and one-cent pieces come and go as public convenience demands, and they do not give us the slightest inconvenience in calculation or account; for their units are decimally related to each other and they are invariably mentally referred to the one money unit, the dollar.

Among the several irrelevant and long-exploded arguments urged by Mr. Spencer, none is "more so" than his Socratic attempt to "array Nature" against the metric system, and it might well be passed over on account of its suicidal character. It may be worth while to remark, however, that the use of the decimal system in dividing the arc of a circle is not in the slightest degree "against Nature," that it is even now being strongly advocated by many eminent European geodesists and astronomers, and that it would be a very decided advance, if brought about, as, in the opinion of many, it some time will be. But it has nothing whatever to do with the metric system of weights and measures. Also, that whenever the English Parliament or the American Congress shall have under consideration an act providing that the year shall consist of ten months, the week of ten days, etc., it is likely that Mr. Spencer will have little difficulty in finding people ready to discuss the merits of such a measure. But these things have no place in the metrological reform under consideration, and their being brought into the discussion occasions no little surprise among those who are accustomed to expect from so eminent a scientific man as Mr. Spencer something like a fair and logical presentation of at least one side of a question.

There appears, however, one inference in reference to the division of a compass dial that is worthy of attention; it is that so inherent is the habit of halving and rehalving that the thirty-two-point division is fixed beyond all hope of change. On the contrary, the practice of ignoring this division is constantly growing, and to such an extent that now a large number of sailing charts and many compasses show circles divided into degrees instead, and many a man at the wheel has told me that he prefers to have the course laid in that way.

But the most astonishing part of Mr. Spencer's argument is yet to come. As he proceeds with his entertaining but somewhat one-sided dialogue, hints of something mysterious begin to appear. The objections to universal decimalization (which nobody has proposed) are put in evidence one by one until the man on the wrong side is led to exclaim in dismay: "You astonish me! What else is possible?" In answer he is asked to join in the contem-

plation of the fact that decimal notation grew out of the possession of a bundle of ten fingers, and the distinguished author might have declared, in harmony with what he has said before concerning time and circular measure, that it was in a very large degree "dictated by Nature." But while affirming that time and the compass have been so riveted upon us as to defy any attempt to change, he leads gradually up to the conclusion that counting by tens is not the only way of counting, and that Nature's group of ten units doesn't mean anything in particular after all. Attention is then called to the greater divisibility of the number twelve, furnishing aliquot parts "which in sundry cases Nature insists upon"; to the fact that we have twelve ounces in a pound (we have also sixteen), twelve lines to the inch, twelve sacks to the last (whatever that may be, De Morgan fails me here), twelve things in a dozen, and that our multiplication table goes up to twelve times twelve! While admitting that "*these particular twelve divisions are undesirable,* as being most of them arbitrary and unrelated to one another," he maintains that they "make it clear that a general system of twelfths is called for by trading needs and industrial needs." No time for breath-drawing is allowed after this astounding bit of logic before one is confronted with the following: "It needs only a small alteration in our method of numbering to make calculation by groups of twelve exactly similar to calculation by groups of ten; yielding just the same facilities as those now supposed to belong only to decimals. This seems a surprising statement, but I leave you to think about it, and if you can not make out how it will be I will explain presently."

In the original chronology of these letters as they were published in the Times it appears that Mr. Spencer's readers were allowed two days in which to think over this "surprising statement," and to recover from any condition into which they might have been thrown by its announcement. I can not refrain from saying just at this point that thousands of American schoolboys would have needed only two minutes in which to explain how it might be done, for it has been common knowledge among arithmeticians from the earliest days of the study of the properties of numbers. In the third letter, however, the thing is gone into at great length, and Mr. Spencer generously shares with the reader the knowledge that it is only needed to invent two characters to stand for ten and eleven, and then we should have a system suited to a twelve-fingered race and greatly superior to the decimal system now in use. It is useless to repeat that all this is old, very old, and it is but justice to Mr. Spencer to repeat that he prepared it from memoranda of his own made more than fifty years ago. No one denies that much advantage might come

from a change in the radix of our numerical system, and some advantages of the present might be lost. An increase in the radix has been recommended for the greater power in computation it would afford, and its decrease has been advocated, even to the extent of suggesting the use of the binary system in which there is but one significant figure, on account of the consequent great simplicity of all calculations. It seems almost certain, however, that, "dictated by Nature," as it is, it will never be changed, as the advantages on either side are small when compared with the magnitude of the problem of a new radix. There are some people who would defer any improvement in our system of weights and measures until the decimal system of notation can be wiped out and one with sixteen as radix substituted, so that if Mr. Spencer was able to bring about such a change as he suggests he would find that his favorite number, twelve, was not alone in the field of candidates for adoption as the foundation of the new notation. Indeed, it is a well-known fact that in the evolution of number systems those not decimal have had their day, but none have survived competition with the many advantages pertaining to that growing out of the "bundle of ten fingers."

In his fourth paper Mr. Spencer again resorts to quotation, and brief reference should be made to the arguments set up by some of his authorities. The letter of Sir Frederick Bramwell contains some remarkable statements. His assertion that the new system will require "more figures to perform ordinary sums than on our present system, when rightly applied," is so grossly incorrect, as may be easily proved by a few examples, that no time need be spent in controverting it. The same might be said of his further assertion that it is more likely to lead to error, and, above all, to the common error in placing the decimal point. This last statement is frequently made, and it is worth while, therefore, to call attention to the fact that in all ordinary business transactions in which the decimal system is used, and in all calculations, for that matter, the error of a misplaced decimal point is one of the rarest of all errors. This is because of the generally quick and certain detection of such a mistake. To misplace the decimal point by the smallest possible amount is to change the result tenfold, and usually so great an error is instantly detected by means of approximate knowledge or other checks. Take our own money system, for example: it is perfectly safe to say that other mistakes are a million times more frequent than a persistent, undetected misplacing of the decimal point. Yet, curiously enough, considerable weight has been given to this objection to the metric system of weights and measures, which is, on the contrary, vastly less liable to errors of computation than that now in use.

Sir Frederick also furnishes an extensive extract, giving the views of the first Napoleon on the subject of reform in weights and measures. Many of the stock arguments are repeated, and if they had not been thrashed over long ago it would be perfectly easy to take them up one by one and show their absurdity. An entire lack of any really accurate knowledge of the subject and an absence of any sort of conception of the simplest metrological principles are shown in a single quotation: "A toise, a foot, an inch, a line, a point, are fixed portions of extension, which the imagination conceives independent of their relations to one another; if, then, we ask for the third of an inch, the mind goes into instant operation. The length called an inch is divided into three parts. By the new system, on the contrary, the mind has not to divide an inch into thirds, but a metre into a hundred and eleven parts." It is difficult to properly characterize such utter nonsense; but, fortunately, the French people, who are to-day the leaders in the world's metrology, were not obliged to take their science, as they were most other things, from the first consul. A group of the most distinguished Frenchmen of any period had perfected this system, even in the very midst of the bloody revolution which closed the last century, and when their final report was made in an address to the legislative chambers by the celebrated La Place, the event was described by Adams as a "spectacle at once so rare and so sublime . . . that not to pause for a moment, were it even from occupations not essentially connected with it; to enjoy the contemplation of a scene so honorable to the character and capacities of our species, would argue a want of sensibility to appreciate its worth. This scene formed an epoch in the history of man. It was an example and an admonition to the legislators of every nation and of all after times."

Mr. Spencer also quotes from an auditor who had to go over £20,000 of accounts, and who was "very thankful that it was not in francs." At first blush it seems entirely natural and creditable to him as an Englishman to rejoice that his twenty thousand is in pounds sterling rather than francs; but, after all, his remark is only a reflection of that not uncommon English sentiment that the imperial monetary system is more perfect than any other in all the wide world. This sentiment is doubtless the outgrowth of national pride and intellectual inactivity; it is not entertained by the majority of the more thoughtful and scholarly Englishmen, and, furthermore, it is in every respect false. It is unnecessary to consume time in quoting the opinion of England's most distinguished scholars, to show that this is not simply an example of American boasting, but I will venture to illustrate by one or two additional extracts from De Morgan. In his arithmetical appendix on Decimal Money he says: "Of all the simplifications of

commercial arithmetic none is comparable to that of expressing shillings, pence, and farthings as decimals of a pound. The rules are thereby put almost upon as good a footing as if the country possessed the advantage of a real decimal coinage." He then proceeds to develop rules by means of which any sum of English money may be expressed in pounds and decimals exactly as our money is always expressed in dollars and decimals, so that any required operation may be easily performed by the common rules of arithmetic. After this the decimals of a pound must be reduced back again to shillings, pence, and farthings. To show how the English system lends itself to easy calculation, I quote his rule, which is only approximately correct, for making the latter reduction: "*A pair of shillings for every unit, in the first place; an odd shilling for fifty (if there be fifty), in the second and third places; and a farthing for every thousandth left, after abating one if the number of thousandths left exceed twenty-four.*" Can anything be more charmingly simple and easily carried in one's head than this?

I must be content to stop without reference to a few other points raised by Mr. Spencer, for they are essentially all of a kind. There is a sentiment underlying much of his argument, to which I must briefly refer, however, because it has shown itself in other recent discussions of this subject. I refer to an anxiety lest the "poor man" be in some way injured by the proposed reform. It has come to be the fashion in all political or economical controversies to exhibit a consuming interest in the poor man's welfare; indeed, one marvels that there should continue to be any poor, so universal and so intense appears to be this anxiety to shield them from all harm. Fortunately, the so-called "poor man" is not so blind to his own interests as some would have it appear, and he is quite alive to the fact that the proposed metrological reform is fully as important to him as to anybody.

Finally, it ought to be understood that the advocates of the metric system do not assume that it can come into use immediately or without considerable hardship. It took nearly a century to fairly establish our decimal money system, which no one would now think of giving up. During all this time old units and denominations continued to be used in a lessening degree, although not authorized by law. Something of the kind must occur in the transfer from our illogical, brain-destroying, time-consuming system of weights and measures for the more perfect system for which it is sure to make way. Furthermore, they heartily welcome and desire the presentation of all arguments against or objections to the metric system, believing that the more widely it is known and discussed the more supporters it

will have. They expect to meet occasionally such "intelligent prejudice" as is exhibited by Mr. Herbert Spencer, whose contribution to the discussion of the subject is sure to be considered in the years to come as altogether the most remarkable to be found in any time or tongue.

NEVADA SILVER.

By CHARLES HOWARD SHINN.

A THIRD of a century ago the surface bonanzas of the Comstock began to yield their treasures. Californians long skilled in gold mining were rushing by thousands into the newly discovered silver districts, and prospecting the mountains and deserts east of the Sierras. In fact, the whole Pacific coast was ringing with shouts of "On to Washoe!" In a few years this obscure, long-neglected corner of western Utah became the State of Nevada. It developed a multitude of mining camps besides the Comstock; it created new forms of mining skill, maintained vast dependent industries, contributed revenues to distant cities, sent forth new groups of millionaires, gave to the world new types of frontier character, and added a dramatic chapter to the story of American commonwealths.

The land itself is worth a moment's attention. It is a high plateau, gridironed by short, parallel mountain chains, the most noted of which is the Washoe Range, separated from the Sierras by a line of small Alpine valleys, and rising, in Mount Davidson, to a height of 7,827 feet. East, south, north, extend weary miles of desert, relieved by a few oases. The scanty rivers of Nevada soon lose themselves in alkaline basins. According to an old frontiersman, reported by Dan De Quille, "the Almighty once started out leadin' a number of small rivers along, meanin' to unite them into one large one, and take it to the Pacific. But before he had more than started it grew late Saturday night, so he tucked the ends down into the sand, where they have remained ever since."

Stephen T. Gage, of the Southern Pacific Railroad, tells an interesting story of Horace Greeley's journey across the continent. The distinguished editor had reached Placerville, California, and had been met by a few ardent followers on horseback. The boisterous mountain town was politically opposed to Greeley, but when the group of young men, of whom Gage was one, brought him out on the plaza for a speech, a great crowd assembled.

"I believe," said Greeley, "that God never made anything without a purpose. But the wilderness that I have crossed is

certainly worthless for agriculture. Unless there shall prove to be great mineral wealth there, it has been created in vain. But if, in the workings of Divine Providence, vast treasure houses are revealed, as I believe there will be, then, my friends, it will take the labor of a hundred thousand California miners a hundred thousand years even to prospect it!"

Even while Greeley spoke a small group of ignorant prospectors, climbing the cañons that slope south from Mount David-

Carson River Cañon.

son, were approaching the Comstock ledge. They were, in fact, already filling their rude sluice-boxes with decomposed rock from the giant lode, and were washing out a little gold, while they threw many a lump of nearly pure silver down the gulches with loud imprecations because the "blue stuff" clogged the machines. These miners were the remnants of several larger camps that had grown, flourished, and fallen into ruins in western Utah during eight or ten years, but they were not the first settlers of the Nevada region. The Oregon trail had three thousand emigrants

on the road in 1846, and as soon as the shout, "California gold!" was heard, the deep-trampled highways across the desert began to be strewed with wrecks of wagons and bodies of horses and oxen. Thousands of men made camp after camp in western Utah without washing out a panful of dust or breaking off a specimen of quartz. Meanwhile Mormon traders, anxious to sell supplies to wagon trains, established small stations along the trail. These traders were often colonists sent out from Salt Lake, under strict orders not to cross the mountains and not to mine for gold. According to a letter in the Sacramento Transcript of October 14, 1850, the hungry emigrants were often forced to sell "a horse, an ox, or a mule for twelve, ten, or even two pounds of flour," and in 1849 matters must have been even worse.

Placer gold was found in the winter of 1849 in a small gulch near Carson Valley, and one or two men worked the deposit, with poor results. The wandering Mormons abandoned their trading posts, but in 1851 Colonel Reese, from Salt Lake, made a permanent settlement. With him came, as teamster, bibulous, featherbrained James Fennimore, afterward known on the Comstock as "Old Virginia," who soon began placer mining in "Gold Cañon." By November the Carson region contained about twenty settlers; miners, herdsmen, and nomads of every description increased the whole population of western Utah to nearly one hundred. Squatter government began, and Congress, with unconscious humor, was petitioned to create a separate Territory for this handful of settlers. The Utah Legislature, with equally unconscious humor, endeavored to hold the region by dividing it into seven huge parallelograms of counties, only one of which appears to have contained any people. The judge sent to Carson County was referred by the Gold Cañon miners to their local "rules, usages, and customs," adopted in the main from California camps.

Local traditions contain much that is worth passing notice. Israel Mott, for instance, "built his house out of the beds of abandoned emigrant wagons." "Ragtown," on the Carson, received its name because of vast heaps of rubbish that marked the camp where the incoming host "ran into the water waist deep to drink like animals," and threw their desert-worn garments in heaps on the cacti and sagebrush. The last night of 1853 there was a dance "in the log house over Spafford Hall's store" at the mouth of Gold Cañon. Eight women were present, and this number constituted "two thirds of all the white women in western Utah." Of white men there were about a hundred—from Lucky Bill's, Fort Churchill, Twenty-six-Mile Desert, Eagle Ranch, and other settlements, as well as from the placer mines.

In 1857 the Mormon settlers were called back to Salt Lake by a messenger from the Prophet. Some fifty families left claims,

cabins, water ditches, and other property, loaded one hundred and fifty-three wagons, and were on the road in three weeks. A few years later one of them, the noted Orson Hyde, wrote to the possessors of a sawmill he had built, demanding its return, and adding: "This demand of ours remaining uncanceled shall be to the people of Carson and Wassau as was the ark of God among the Philistines. You shall be visited of the Lord of hosts with thunder and with earthquakes and with floods, with pestilence and with famine, until your names are not known among men." The letter was printed, and the camps of 1860 rang with loud laughter. But in 1857 no one could see anything amusing in the departure of the Mormons. Emigrant travel had ceased, traders had gone, villages were deserted, plows left in the furrows, cabin doors flung open. Even Gold Cañon placers were nearly exhausted. Everything seemed "played out."

The early miners of Nevada knew nothing of prospecting as a business. They were so thoughtless and ignorant that it never occurred to them to look for the source of the metal they were obtaining in Gold Cañon and other ravines that headed in Mount Davidson. The little gold they found became more and more alloyed with silver, so that its value decreased from nineteen dollars an ounce to twelve dollars. The camp of Johnstown in Gold Cañon, where they wintered, dwindled in size, and discouraged miners went to other districts. Meanwhile two prospectors of education and ability, the Grosh brothers, were secretly exploring the Washoe Mountains for silver. Their letters home prove that they found "a monster vein" and other good prospects, and they began to organize companies in the Atlantic States and in California to work these claims. But one brother died from an accident early in 1857; the other lost his life in the Sierra the following winter. The first knowledge of the Comstock perished with these two brave, thoughtful, reticent young prospectors.

All the men who aided in the discovery of the famous mines wintered in Johnstown in December, 1858. Among them was one Henry Thomas Paige Comstock, a curiously ignorant, credulous, and speculative miner, familiarly known as "Old Pancake." "My first recollection," he wrote, "is packing beaver traps; trapped all over Canada, Michigan, Indiana, and the Rocky Mountains." Comstock, "Old Virginia," Peter O'Riley, Pat McLaughlin, "Kentuck" Osborne, "Long John" Bishop, Manny Penrod, Sandy Bowers, and a few others had been more or less together. Sometimes they were in Gold Cañon, sometimes in Six Mile Cañon, sometimes crossing from the head of one to the head of the other, along the side of Mount Davidson, over the top of the Comstock ledge. In January, 1859, a streak of warm weather tempting

some of them out, Comstock, "Old Virginia," and several others found "surface diggings" near "Slippery Gulch." They named the place "Gold Hill," and, staking out claims, proceeded to work the decomposed outcroppings over Crown Point, Yellow Jacket, Belcher, Kentuck, and other great mines as yet undiscovered. From the time they started the rockers, using water from a spring close by, Gold Hill averaged twenty dollars a day to the man. June 1st, O'Riley and McLaughlin, whose claim in Six Mile Cañon paid only two or three dollars a day, suddenly cut into the rock on the surface of Ophir, at the north end of the Comstock, and began to take out gold at the rate of a thousand dollars a day. They had only been working a few hours when Comstock happened along, saw the value of the discovery, laid a general floating claim to a mythical stock ranch in the region, and fairly bluffed the good-natured discoverers into taking himself and Manny Penrod as equal partners. "Kentuck" Osborne afterward came in, and the five took up the original Ophir claim.

The miners in the region soon staked out claims around Gold Hill and Ophir. "Dutch Nick" started a saloon and restaurant in a tent. "Old Virginia" went on a spree one night and christened the north-end camp "Virginia City." Comstock bubbled with happiness, and flung his money broadcast. But a rancher from Truckee Meadows, visiting the camp, picked up some of the despised "blue stuff" from the waste heap of Ophir, and afterward gave it to Judge Walsh, of Grass Valley, California, with the remark that "over in Washoe the miners were throwing it away." An assayer reported it to be nearly pure silver. This happened about midnight, and before dawn Judge Walsh was miles on the road to Virginia City, while hundreds of other men were making ready to follow. The Truckee Meadows rancher paid no attention to the excitement he had caused, but went quietly back to his farm. When Judge Walsh reached the camp Comstock sold for $11,000, only $10 of which was paid down. McLaughlin soon sold for $3,500, Osborne for $7,000, Penrod for $3,000. Careless, ignorant, the first Comstockers were blown aside like leaves in a whirlwind. They spent their money and drifted off here and there, pursued by ill-fortune. McLaughlin was soon cooking for a gang of men at $40 a month; "Old Virginia," while on a spree in 1861, was thrown from a horse and killed; Comstock, who had parted with his interests exactly two months after the ledge was struck, branched out into financial and matrimonial ventures, spent every dollar, wandered over Idaho and Montana vainly looking for another fortune, and in 1870 committed suicide. Sandy Bowers, who was considered a millionaire, went to Europe with his wife "to see the queen," and "had money to throw at the birds." He built a costly stone man-

Virginia City, Nevada, looking toward the Divide, etc., to Gold Hill.

sion in Washoe Valley before birds of prey obtained all his money. His widow, the "Washoe Seeress," made a living for years by curiously futile predictions regarding the stock market, and still reads the future for those who care to listen. One after another all the placer-mining Comstockers went down before the rush of silver seekers.

That rush was in many respects the most remarkable one that California ever had known. Decidedly the best account was written by J. Ross Browne, who made his Peep at Washoe a classic of early Nevada. Stirred, he says, by the shout of "Silver! silver! Acres of it! Miles of it!" he left San Francisco in March, 1860, and made his way to Placerville. Beyond this point there were no stages. The town was full of men anxious to cross the mountains, and "practicing for Washoe" in the saloons. Every sign bore Washoe in large letters. Pack trains were starting daily for the mines. No animal could be had for love or money. "Lodging accommodations" consisted of enough floor space on which to lie in one's blanket.

The next morning Browne started on foot. The muddy trail was literally lined with broken-down vehicles and goods of every description. He stopped at nightfall in "Dirty Mike's" shanty, in which the bar and the public bedroom were the chief features. The second day hundreds of persons were in sight along the trail—men with wheelbarrows, handcarts, donkeys, mules; gamblers on fancy mustangs, whisky peddlers, organ grinders, drovers, Mexicans. Rain, snow, and slush prevailed for miles before he reached the log cabins of Strawberry. There he slept on the floor with about forty other pilgrims, and had his stockings stolen, which "were above gold or silver in this foot-weary land." Three feet of snow in the morning, four hundred men in the camp, and provisions low; eight hard miles to the summit, nine more to Woodford's. Browne and several others tried the trail, but were forced to return to Strawberry. The next day he tried it alone. The trail was over old snow, honeycombed with holes hidden by the new snowfall; pack trains were floundering through and occasionally falling into the cañons. Wind and sleet all day; mud knee deep in Hope Valley; all in all a terrible day's experience. The fifth day Browne's course was along the Carson. He was so worn out that he could only cover about eighteen miles between sunrise and nine o'clock at night. The sixth day he arrived at Carson City, and took the stage for the mines.

Virginia City, as Ross Browne saw it in the spring of 1860, lay outspread on a slope of mountains, speckled with snow and sagebrush and mounds of upturned earth. The dwellings were rude board shanties; tents of blankets, sacks, old shirts, and canvas; huts of mud and rock, caves in the hillside, and hollow heaps

of brush. Piles of goods were scattered about in the rain and snow. A scathing wind, the "Washoe zephyr," tore the huts apart and filled the air with gravel. Crowds were gathered in open places, trading claims or fighting over them. Other crowds were drinking and gambling in the numerous saloons. Rough, unkempt, unwashed miners, speculators, bummers, thieves, cutthroats filled the raw, unsightly mining camp with horrible confusion. "In truth," says our artless adventurer, "there was much to confirm the foreboding with which I had entered the Devil's Gate."

In a short time the demands of the Washoe country developed a complete system of transportation over three great toll roads, the finest on the Pacific coast. Massive freight wagons, marking in every detail the utmost skill of California workers in wood and iron, carried all the supplies for Nevada. Bearded and weather-beaten freighters, who were also owners of their outfits, walked beside the great mule teams. Each freighter carried his rod of empire, a short hickory handle to which was attached a long, close-plaited whiplash as big as one's wrist at the swelling part. At first receiving twenty-five cents a pound for whatever was carried between Sacramento and Virginia City, and hauling a thousand pounds to the animal, the freighter in a year or so was able to move twenty-four tons besides the wagons, with a sixteen-mule team, at a cost of four cents a pound for the entire distance. It is said that there is not on record in courts or newspapers a single instance of the loss of goods in transit either by fraud, force, or carelessness during all the years of the Nevada freighter's glory.

One stage line carried twelve thousand passengers to Nevada in 1863. Schedule time in 1861 had been three days for the one hundred and sixty-two miles, but it was soon reduced to eighteen hours. Three wealthy mining operators were once taken from Virginia City to the steamboat wharf in Sacramento in twelve hours and twenty-three minutes. Old travelers still recall with pleasure the ride across the mountains on the Placerville route. Its most striking moment was when one first saw from the summit of the pass the hyacinthine waters of sealike Tahoe and the level desert. "The eastward-gazing grizzly bear," to quote from one of the stories written by an old Elko silver miner, the late Dr. Gally, "lifts his flexible nostril to sniff the odor of the arid waste, then slowly turns and prowls westward. There is a visible line eastward where two worlds appear to meet. Beyond is the great 'empire of Artemisia,' where gold and silver were married in the volcanic chambers of the awful past. One sees the land of Washoe outstretched from the mountain tops, with its browns and grays, its arid junipers and dull nut pines, its crags of lime-

stone, basalt, porphyry, granite, in naked barrenness. There, underfoot," writes Dr. Gally, "the world is dry, gray, silent. Overhead, during the long cloudless day, it is pale blue, dry, silent. All abroad it is gray or dark with mountain distance, and it is silent. Silence is everywhere. No roar of far-off torrents tumbling down the hills to jar the night air underneath the stars —the stars still are, but all the torrents have departed. At some lost period backward of all dates, the Great High Sheriff of the universe in open court has cried Silence and has been obeyed."

Into such a land the silver seekers came, and it claimed them for its own. Soil, climate, topography, environment, began to create the Nevada type, with its large freedom, its quick comprehension, its broadly humorous buoyancy, and similar characteristics that one finds abundantly illustrated in such books as Mark Twain's Roughing It and in the writings of a great group of younger newspaper men. "Desperate climatic humor" is what Dr. Gally calls it. Occasionally an old copy of an early Nevada newspaper turns up, fairly scintillating with wit and sarcasm, but for the most part the files have been destroyed in the great fires. Said brave old De Quille, companion reporter with Mark Twain on the Territorial Enterprise:

"I used to make the newspaper my notebook for years, and I thought what a book I could write some day out of that notebook; but now I don't know of a single file in existence."

Still there are gleams of the past in stray copies that have escaped the fires. Senator Stewart was the most prominent man on the Comstock in the days before Sharon, and the Gold Hill News, amazed at his audacity, once likened him to the Colossus of Rhodes—he was as large and contained as much brass. Mark Twain, in his forgotten Proceedings of the Third House, once burlesqued nearly every member of the Constitutional Convention of 1863. Larrowe, of Landor, for instance, was made to glorify the "nine sceptered and anointed quartz mills" of his district until the president ordered him to "hold his clatter" and drop Reese River quartz-mill statistics. Mr. Stewart, after a long speech on miners' taxes, was told: "Take your seat, Bill Stewart. I have been reporting and reporting that same infernal speech of yours for thirty days. . . . You and your bed-rock tunnels and your blighted miners' blasted hopes have gotten to be a sort of nightmare to me and I won't put up with it any longer." The wealth of material in this field would fill volumes instead of paragraphs.

Hardly had the first rich ore been taken from the Comstock when an age of litigation commenced. The early claims overlapped and were badly defined, some being taken up under placer rules, others as quartz claims, and all without accurate surveys. Mat-

ters went from bad to worse, as every one had access to the record book in the pioneer camp, and most of the prospectors changed their stakes and boundaries as often as seemed best. The most casual study of the Comstock region in 1860 reveals the wildest Walpurgis-night revels of conflicting claims of every size, shape, and age tumbling over each other three and four deep. Besides, the Virginia lode was parallel to the Comstock, and many lesser veins crossed it or ran near, thus giving rise to the great legal problem of the day, Was the Comstock one ledge or two ledges?

Then followed the famous mining cases that fill volume after volume of the Nevada reports—Savage against the Bowers Company, Chollar against Potosi (pronounced Potoseé by all old "Cōmstôckers"), Burning Moscow against Ophir, and others of

Flash-light of Drills in Nevada Mine.

equal interest. The total number of lawsuits for twelve mines during this period is 245, and 168 of these were "actions brought" to dispossess the claimants of ground that, under the single-ledge theory, belonged to the first locators. The direct cost of this litigation was $10,000,000, or one fifth of the entire product of the lode during the fighting period. Pitched battles occurred underground; mines were flooded with water or filled with smoke. Forts were built, armed men employed, and battles fought on disputed claims. Some of the best mining lawyers of America were trained in this age of litigation. Stewart, known as "Old Invincible," tireless in devotion to his clients, received $100,000 from Belcher and $30,000 as a single fee from Yellow Jacket. The reputation of the Territorial courts suffered, and some of the judges resigned under stress of public wrath. Lord, in his History of the Comstock, sums up the period from 1860 to 1865 with

the terse remark that "the Washoe bar at that time was hardly a nursery for tender consciences."

The first problem that troubled the miners in the midst of their lawsuits was how to handle the immense bodies of ore. To develop the various claims by means of the usual shafts, tunnels, drifts, cross-cuts, and other underground workings was unusually difficult. The vein matter of the great fissure varies from 100 feet to 1,500 feet in width. The whole body was once a seething mass of fire and steam. It still remains in many places so hot that the appliances of modern science hardly enable the miners to accomplish any work. The ledge first sloped west, became vertical at about 200 feet down, and then bent toward the east, thus necessitating a second and finally a third line of shafts. Machinery for pumping, for hoisting, for ventilating and lighting the depths of the mines, had to be constructed upon a larger scale than ever before attempted. As the ore bodies were opened they were found to be so wide that the timbering system failed entirely. A new method, known as the "Deidesheimer square sets," was invented, which is still in use in all large mines. It consists of short timbers mortised together in frames that can be built up to any height or width, like the adding of cells to a honeycomb. A few years later the mines siphoned water from the Sierras under a pressure of 1,720 feet. Incidentally the miners invented the V flume to carry lumber down the Sierra slopes. The annual supply of timber for the mines amounted by 1866 to 25,000,000 feet of lumber and 170,000 cords of fuel. The consumption of both increased steadily until in bonanza days 80,000,000 feet of lumber annually disappeared into the drifts and chambers and 250,000 cords of wood went up in smoke and flame.

Metallurgists, too, found endless study in the methods of reducing Comstock ore. Beginning with slow Mexican *arastras* and *patio* yards, adopting in 1860 California stamp mills, and modifying the amalgamating apparatus to save the silver, the modern "Washoe process" was finally adopted, though only after years of costly experiments. For a time every one went rainbow-chasing for something to perform impossible chemical feats. One pioneer mill man used to put strong decoctions of cedar and juniper bark into his amalgamation pans; others actually used sagebrush tea, it being argued that Nature had created the otherwise worthless shrub for the express purpose of getting the metal out of Nevada's mountains! Persons with secret processes overran the mining districts, each one with the whole trick contained in a little bottle in his vest pocket, ready for a consideration to pour a few drops into the amalgamating pan. San Francisco was ransacked for drugs to put into the batteries with the pulverized ore. Alum, saltpeter, borax, potash, all the acids obtainable, tobacco

enough for a "sheep-dip," a multitude of articles never before used by miners, such were some of the contents of the Nevada mill men's witch caldrons in the early sixties. "The object appeared to be," says an amused observer, "to physic the silver out of the rock."

Ruins of Old Mill near the Comstock.

Slowly, after immeasurable waste, crude methods gave way to better ones. Mills were built in Washoe Valley, in the cañons, and on the Comstock, but the greater number were along the Carson River, so as to be run by water power. No less than 76 mills, costing over $6,000,000 and carrying 1,200 stamps, were in operation before the end of 1861. Some of the mills of the period are still remembered for their extravagant construction. Gould and Curry built one on a terraced hill where the mine owners spent about $1,000,000 in picturesque and useless magnificence. After a few years, when their bonanza began to fail, it was found that the reduction of their ore was costing fifty dollars a ton. The machinery was thrown aside, and it required $600,000 to put the mill in working order again. Everywhere, through years of readjustment, mills were torn to pieces, rebuilt, enlarged, made to do better and better work, until the results produced when the great bonanza mines were running at full speed attracted the attention of mill men all over the world.

What is known on the Comstock as the old group of bonanzas began comparatively near the surface. The yield of the diggings of 1859 had been about $100,000 for the entire lode. In 1860 it yielded in round numbers $2,000,000. After that the mines were developed so fast that by 1865 the output of Storey County, most of it from the Comstock, was $9,500,000. During twelve years after 1859 the product of all the Comstock mines was $145,000,000.

Work went on with increasing zeal. Mines that were in "*borrasca*," or barren rock, were kept going by immense assessments. If the present business methods that prevail in mining had been adopted on the Comstock, half of this enormous yield of $145,000,000 would have been clear profit, but the greater part of every bonanza went into running and extraordinary expenses. Reckless waste and superb enterprise seemed to go hand in hand. The numbers of relatives and friends that the owners of the mines managed to support by making positions for them can hardly be reckoned. Everybody, from servant girls to bankers, speculated in Comstocks and other mining shares.

In 1860 more than five thousand claims within thirty miles of Virginia City were "on the market." Frenzied prospectors were marking out thousands more, until the most remote corners of the desert were "pegged down with claim stakes" set on indications which were seldom attractive to a mineralogist. Iron pyrites and all sorts of worthless combinations seemed as good as gold or silver to the enterprising adventurers. Before long men were claiming to have found huge ledges of iridium, platinum, and plumbago. One Washoe speculator being told by a gentleman that an ambergris mine would be valuable, replied that he had just staked out one! A company tunneled for weeks into the granite of Mount Davidson in order to tap an alleged lake of coal oil.

No one can reckon up the number of prospect holes that dot Nevada. Millions of them, mere ragged cuts or pits in the tawny hillsides, make wind-blown heaps on every hand between the clumps of dark sagebrush and the dull yellow of an occasional sunflower. Only one prospect hole in a hundred ever materialized into a recorded claim; only one claim in a thousand ever became a mine. Up to 1880 Virginia City and Gold Hill alone had 16,000 registered claims, and less than a dozen really great mines. To sum it up, the amount of dead work and wasted capital in every mining region almost surpasses belief. Ruins of mills and dwellings, nameless graves in the canoñs, fragments of old trails washed by the storms of thirty winters, are all that mark the sites of many once-aspiring districts. In Esmeralda and White Pine, which the late Dr. DeGroot used to call "those Golgothas of Nevada speculators," what millions were fruitlessly scattered!

The entire history of the Comstock lode is revealed by the assessments, dividends, and fluctuations of the stocks of separate mines. Before the close of 1861 eighty-six companies were working on or near the great lode. Gould and Curry, a marvelously rich mine, declared $2,908,800 in dividends in 1863 and 1864. This was upon an actual investment of less than $200,000. But the ex-

penses of the mine, which worked 110,000 tons of ore during those two years, were nearly $6,000,000. It is believed that twice as much could easily have been paid in dividends, but, as the president of the company said, "every shareholder was crazy and wanted it snaked out at once at any cost." Gould and Curry, July 1, 1863, was selling at $6,300 per foot (the old way of measuring values); in July, 1864, it was worth only $900. Belcher was one of the dividend mines of the Comstock, having paid $16,000,000 up to 1880. It had 104,000 shares after 1869. In that year prices ranged from $12 to $35; in 1870, sank from $36 to $1; in January, 1871, rose to $6, and in December to $450; in Janu-

Alta Mine, Mill, and Dump, Gold Hill.

ary, 1872, sank to $6, and in April rose to $1,525, fluctuating all that summer down to $1.50, up to $95, and back and forth after this fashion for years. Once it rose in a month from 25 cents to $113 a share. Out of 103 Washoe mines listed, only six ever paid more money in dividends than they levied in assessments. These six were Consolidated Virginia, California, Belcher, Crown Point, Gould and Curry, and Kentuck. Some of the assessments levied upon mines that never paid a cent to the stockholders remain unparalleled in mining history. Ten mines sank nearly $17,000,000 before 1880. Assessments on Bullion were $3,352,000; on Overman, $3,162,800. Alta, Baltimore, Caledonia, Mexico, Imperial—these and other non-producers are still remembered with sorrow by thousands of investors.

Nevertheless, viewed as a whole, the Comstock was immensely profitable. In twenty-one years from the summer of 1859, according to Government reports, the mines levied in assessments $62,000,000. The dividends paid during the same period aggregated $118,000,000. Striking a cash balance, the Comstock ledger shows an actual profit of $56,000,000. The total bullion yield for the same period was $306,000,000. Subtracting dividends and adding assessments, we find that the cost of purchasing, maintaining, defending, and developing the great lode for twenty-one years was $250,000,000. Three fourths of this sum came from the mines themselves, the other fourth was gathered from direct assessments. The prospectors and original locators had received less than $100,000. The various owners paid less than a million dollars out of their own pockets, as working capital, before assessments and the stock-gambling period began. Since 1880 the yield of the Comstock has been decreasing, and many of the mines have been shut down. The ledger account of the Comstock with the public remains practically unchanged.

The most dramatic events in the story of the Comstock cluster about a series of struggles for its control during the ebb and flow of alternate borrasca and bonanza. Nothing was lacking to make the period impressive. The financial leaders of the Pacific coast were conquering Nevada, while another group of men were winning victories that shortly led to the culminating treasure of the lode, and while the indomitable Sutro was toiling in his great tunnel. So vast and ruthless was the battle that its far-reaching results still influence politics and social life of California and Nevada; men still divide upon issues which began in the depths of the Comstock a quarter of a century ago.

In 1864 the ore deposits were worked out, and rayless gloom settled over the Comstock. The Bank of California, through its resident agent, William Sharon, had been making advances on mills and allowing the mine owners to overdraw their accounts. The security in both cases was only undiscovered ore, and if the lode were really exhausted the whole camp was ruined. Ralston, the head of the bank, visited Virginia City in 1865, and agreed with Sharon that the time had arrived to gain control of the district. Loans, instead of being lessened, were increased, to what extent is not known, but it was afterward said by Sharon that at one time before 1870 $3,000,000 of the $5,000,000 capital of the bank was on the Comstock. In June, 1867, the famous mill and mining company was formed by W. C. Ralston, William Sharon, Alvinza Hayward, D. O. Mills, Thomas Bell, Charles Bonner, William E. Barron, and Thomas Sunderland. It was the strongest possible combination of capitalists and mining men; its business was to manage the mills and mines that had now fallen into the

hands of the Bank of California through foreclosure and through manipulations of stock. It also aimed at securing control of others, and ultimately at directing the output of the entire lode.

There are, let me explain, two systems of handling ores. A mine can own its mills, or it can send to a custom mill. On the Comstock the mine-owners' experiments in building mills had proved disastrous. The independent millman was a more efficient ore-worker than a salaried superintendent. But the Comstock system did not secure the permanent welfare of the outsiders. What Prof. Raymond calls "the piratical policy of gutting the mines" was carried on in bonanza times at such a shocking rate of speed that it unduly stimulated the building of more mills, and then left the mines totally unable to sustain any of them. It is not surprising that the Union Mill and Mining syndicate were soon able to gather in seventeen of the leading mills and to keep them running on ore, while outside mills could not make a living. It became evident that the substitution of Sharon for Stewart as the leading personal force on the Comstock was in reality the most complete revolution the sagebrush land had yet known.

Nevada had long "talked railroad." Legislatures, Territorial and State, had granted many charters, but after a few abortive efforts the last of these haphazard schemes was dead. Sharon, the man of affairs, sent for James, of the Sierra Nevada Mine. The following conversation is said to have occurred:

"Can you run a railroad from Virginia City to the Carson River?"

"Yes."

"Do it at once."

Within thirty days the winding course, twenty-one miles long, was surveyed; graders were at work; rails were on the way; men were hewing ties in the Sierras; an obedient Legislature had passed a new charter and had authorized $500,000 in bonds as a bonus to the road; lastly, the mines had subscribed $700,000. It was a busy month, even on the Comstock. Extended to a junction of the Southern Pacific at Reno, the Virginia and Truckee Railroad cost about $3,500,000. The maximum grade is 116 feet to the mile; the curves of the track in the thirteen miles and a half of mountain distance make seventeen full circles, and the rise is 1,600 feet.

Sharon had put Chinese graders at work, but the miners' unions of Gold Hill and Virginia City marched out a thousand strong. The sheriff halted them, and they sat down on the rocks to hear him read the riot act. That ended, they rose with shouts of Homeric laughter, gave three cheers for the sheriff, and moved resistlessly on the graders' camps. The Chinese "ran like rabbits" up the gulches. The miners told the boss to quit work, and,

marching back, sent word to Sharon that no Chinamen would be allowed in the district under penalty of a strike that would shut down every mine on the lode. In twenty-four hours the Chinese were dismissed and white graders took their places. Defeated here, Sharon silently made ready for the real labor conflict that he foresaw. It began when the first trains entered Virginia City. The fine old silver freighter, in Nevada slang the "mule skinner"; the bull-puncher walking sedately beside his oxen; even that aristocrat of the fraternity, the lordly "silk-popper," flicking his playful whiplash at the leaders as he drove his stage-coach down Geiger's grade—these, all these, after fierce, useless struggles, disappeared into the unrailroaded distance. "Sharon's iron mules," as they said, "had crowded them off."

Meanwhile the total bullion yield of the lode, which was $16,-000,000 in 1865, continued to decrease till in 1869 it was only $7,500,000. None knew better than Sharon and his associates that although borrasca had put them into possession, a few more years of borrasca would utterly smash their fortunes. There had been in all eleven bonanzas up to 1869, but now all were "worked out," and the ordinary ore in the mines not only grew poorer and scantier on the lower levels, but was harder to work. Everything was in eclipse. The miners were following a mere stringer of ore on the nine-hundred foot level of Yellow Jacket that gave Sharon a little hope, but troubles with the miners and disastrous fires intensified the situation. By 1870 some of the members of the syndicate began to weaken; it was openly said that the Comstock had paid its last dividend; the cities of the lode were trembling on the verge of panic.

The famous John P. Jones, since United States Senator, was superintendent at Crown Point, and, like all the rest, was vainly looking for ore. The stock fell to two dollars a share, making the total value of the mine, with its costly plant, only $24,000, and assessments went unpaid. Late in 1870 Jones found an ore body, and, joining forces with a discontented member of the bank syndicate, wrested control of the mine from Sharon before he knew of the bonanza, which in eighteen months more raised the stock-market value of Crown Point to $22,000,000. They also organized the Nevada Mill and Mining Company in direct opposition to their old associates. Nevertheless, Sharon's lesser defeat only emphasized a greater victory. His interests in other mines doubled and quadrupled in value, empty treasuries were filled by outside investors, and search for new ore bodies was prosecuted with renewed energy.

The story of the rise of Mackay and Fair reads like a leaf from the Arabian Nights. Like Jones, they had been poor and unknown, working for daily wages. Associated with Flood and

O'Brien, they discovered the Big Bonanza, the richest treasure of the Comstock. Mackay outranks the rest of the group, because his rise was more remarkable and his grasp of circumstances more firm. From toiling in the lower levels he rose to be superintendent of one of the smaller Gold Hill mines. Like Fair, he saved every dollar and put it into stocks under his own control. Before long he was interested in "Kentuck," a rich little mine, and it began to pay dividends again. His own statement is that for years he had labored with all the powers of mind and body to make himself "master and manager of the greatest mines in the world." Kentuck gave him the start. Mackay and Fair, now associated in every enterprise, ventured to make a fight for the control of Hale and Norcross, which they acquired in March, 1869, its stock, like everything else on the lode, being greatly depressed. Fair, leaving Ophir, of which he had long been superintendent, soon put Hale and Norcross on the dividend list. Old Comstockers still praise "Uncle Jimmy's fine nose for ore." The mining skill of Fair, as well as of Mackay, rose at times into the domains of genius. Before the close of 1869 they controlled Savage and Bullion. This proved a bad affair, and nearly ruined them. The Bank of California millionaires began to feel relieved in mind. In a year or two, they said, Mackay will be back in the face of a drift, at four dollars a day, and Fair can be made useful somewhere on a superintendent's salary. But the Mackay firm, still convinced of the reasonableness of their system of exploration, concentrated their last resources upon a long-neglected portion of the lode.

The Comstock mines begin at the north with Sierra Nevada, 3,300 feet on the lode; coming south, Union Consolidated follows, 600 feet; then Mexican, the same size; then Ophir, 675 feet. All these were being worked on a large scale. Next came a group of small neglected claims whose titles were in dispute, 1,310 feet in all, followed by Best and Belcher, Gould and Curry, Savage, and Hale and Norcross, which completed the famous north-end, or Virginia City, group of mines. The neglected section, 600 feet of which was afterward known as California, and 710 feet as Consolidated Virginia, was worth only $40,000 on the stock market. As Mackay and his associates bought, the stock rose; the three-fourths interest they desired cost $100,000. They took control in January, 1871, and began mining operations, sinking a new and large shaft and pushing a drift north from Gould and Curry, nearly 1,200 feet below the surface, by a special contract with the owners of the mines crossed.

One day Fair discovered a slight change in the barren rock and determined to follow a narrow seam hardly thicker than a knife blade. Sometimes it was only a film of clay, but occasion-

ally a pin point of ore was seen. For hundreds of feet the miners drifted beside this slender clew. Fair became ill, and the workmen lost it, but on his return he picked up the ore thread. They were now a hundred feet in Consolidated Virginia ground, and the price of the stock began to break, when suddenly the stringer widened to a vein of sixty-dollar ore. In October, on the 1,167-foot level, the top of the "Big Bonanza" was uncovered; the drift went 148 feet through solid ore 54 feet wide. The great kidney-shaped mass extended downward below the 1,500-foot level, and widened to 150 feet and even to 300 feet. The ore grew

Gould and Curry Miners ready for Work.

richer and richer as the men advanced. Nothing like it had ever been known in the history of mining.

Here, in the heart of the Comstock, hundreds of naked miners were soon hewing down the ore. On all sides of a pyramidal mass of timber which grew larger every minute were twinkling stars of lamps. Everything in the bonanza was sent to the mill as fast as it was quarried out, and some of it was so rich that waste rock was added to aid amalgamation. An average block of ore three feet square contained from two hundred to five hundred dollars in silver and gold. The richest spot was near the California line, where clusters of malleable silver in coiled wires occurred beside shining stephanite, pale-green and steel-gray chlorides, and lustrous black silver glance, besides masses of the most exquisite crystals of every color known to the mineralogist.

In six years Consolidated Virginia milled 682,355 tons of ore, producing $60,732,882; California, in four years, milled 486,043 tons, producing $43,727,837. The total yield of the Big Bonanza had been nearly $105,000,000, and more than $73,000,000 had been

paid in dividends. Extreme haste was necessary in extracting the ore, so great was the danger of a disaster. Mackay and Fair hardly rested day or night till the bonanza was exhausted. Outside, all the exchanges of the world were fighting over Comstocks. The two mines, rated in 1871 at $40,000, were rated in 1875 at $160,000,000. Thirty mines on the lode were now valued at about $400,000,000. So much money was withdrawn from legitimate business and flung into the stock market that when the inevitable crash came and the Bank of California failed, every industry of the Pacific coast was checked for years.

In the midst of the bonanza excitement Virginia City was swept by a great fire, the culmination of a long series of mining disasters, and in a few hours a territory half a mile square was a mass of ruins. The mining companies lost acres of supplies and lumber; Ophir, Consolidated Virginia, and California had all their buildings burned; two thousand stores, hotels, lodging houses, and dwellings were destroyed. The very next day men were at work in the ruins, on the rugged hillsides, in the ravines, by the monstrous waste dumps, clearing away, rebuilding on a still more massive scale the giant machine shops, hoisting works, and mills. The two bonanza mines lost $1,500,000, and yet they managed to keep up regular dividends at the rate of $1,080,000 a month!


ADOLPH SUTRO.

All these years one indomitable mill owner and engineer, Adolph Sutro, had been fighting single-handed the men who controlled the Comstock. Away back in 1860 he had advised a deep adit, and in 1865 he obtained a franchise for the Sutro Tunnel Company, with Senator Stewart as president. The mining companies bound themselves to pay perpetual royalties after the completion of the tunnel. Congress, assuming the regulation of the immense mining interests involved, passed an act which, still further protecting the enterprise, made the very titles of the mining companies dependent upon the fulfillment of their obligations. Large subscriptions were made, and

it was expected that the bonds would sell readily. But early in 1867 the Bank of California syndicate began to perceive that the Sutro Tunnel, delivering ore at the Carson River mills and mining supplies nearly two thousand feet below the surface, might very easily destroy their control of the Comstock and its dependent industries. Therefore they declared war, and opened hostilities. Stewart resigned; subscriptions were all withdrawn; shrewd lawyers and politicians were employed to obtain the repeal of the franchise and of the act of Congress; financiers in New York and Europe were warned not to touch Sutro bonds.

Years after Sutro said in conversation: "Ah, it was a hard thing to have so many old friends in San Francisco and Virginia City actually afraid to be seen talking to me after the fiat had gone forth that I must be crushed at any cost. But I kept on fighting. There was one time, I remember, when I had to go to Washington to save my interests from destruction. I had no money. All the profits of my mill had been swallowed up. But I had a lot in a little California town, and I sold it for two hundred dollars, and with that I managed to get to Washington. I stayed there somehow that winter, poor as I was, and fought my enemies, and came out ahead. But their newspapers said I had bribed Congress—out of my two hundred dollars!"

After making the most strenuous efforts Sutro failed to place his bonds. In 1869, turning for help to the working miners, he delivered a remarkable address in Virginia City. Large cartoons illustrated his bitter eloquence. One showed Bill Sharon's Big Woodpile, another Bill Sharon's Crooked Railroad, a third the then recent fire in Yellow Jacket, where forty-two lives had been lost that might have been saved had the Sutro Tunnel existed. He appealed to the miners' unions for stock subscriptions with which to begin work. "Will the people of Nevada see me crushed out now? . . . Come in together. Let two thousand laboring men pay in ten dollars apiece a month, and insure the construction of the tunnel, carrying with it the control of the mines. . . . From dependents you will be masters." With such sentences he addressed the working miners of the Comstock, who actually raised fifty thousand dollars in a few weeks, and on October 19th resolute Sutro broke ground in his great undertaking. Nevertheless the tunnel was steadily opposed by the California and Nevada Senators and by nearly all the mining men on the Comstock. The history of the long struggle is embalmed in the pages of the Congressional Record and innumerable public documents. Sutro bonds were finally sold, but the difficulties of the undertaking proved greater than had been expected, and the period of the bonanzas passed before the lode was reached.

The progress of the work was dramatic. The face of the rock "showed a temperature of 114°." Two or three hours was all that the strongest men could work. Endurance was strained to its utmost capacity. Man after man dropped down on the rocky floor and was carried to the surface babbling and incoherent. This strenuous toil continued till July 8, 1878, when Sutro himself, half naked like one of his miners, labored at the front, and finally crawled through a jagged hole into the Savage drift, "overcome with excitement," as one of the newspaper accounts

Sutro Tunnel, Sutro, Nevada.

said. What had been contemptuously called "Sutro's coyote hole" thus became an accomplished fact.

Through such passionate conflicts as those described the heroes of the Comstock continued making workshops, mills, machinery; building two marvelously picturesque towns along the lode, and hiding underneath the greater creation—the real City of the Comstock. Here, in deeps below deeps, are three-mile streets, mysterious labyrinths, water torrents, burning heats, perils numberless, legends that might serve to fill a volume. Time was when twelve thousand miners toiled in these vast galleries, swinging picks, hammering drills, raising timbers to place, climbing to the stopes, breaking down the ore, pushing lines of loaded cars to stations on the hoisting shafts. They were superb athletes, with muscles evenly developed by their labor. A few of them remain, scraping out the ore left in older workings and maintaining to the fullest degree the fine old-time pride of their craft. For sixteen years, however, the mines have been

in borrasca, and they may never again pay a profit to their owners. Still, with faith and endurance that are sublime, the heroes of the Comstock cling to its fallen fortunes, and continue the search for new bonanzas.

[Editorial Note.—The full story of the mines, as illustrated by the great Comstock lode, prepared by Mr. Shinn, will constitute the next volume of the Story of the West Series, edited by Mr. Ripley Hitchcock, to be published by D. Appleton & Co. in October. Our readers need hardly be told that Mr Shinn has special qualifications in his familiar acquaintance with the subject and his rare literary skill, which will impart special interest and value to this work.]

A MEASURE OF MENTAL CAPACITY.

By Dr. EMIL KRAEPELIN,
PROFESSOR OF PSYCHIATRY AT HEIDELBERG.

(From an Address delivered in behalf of the Heidelberger Frauenverein.)

We are able to calculate almost precisely the amount of work any given machine—as a steam engine or an electric-lighting plant—is capable of performing, and the amount of fuel that will be required to develop the calculated power. When we come to man we are much less certain, although a skillful army surgeon can tell almost at a glance whether the recruit standing before him is strong enough to meet the requirements of the service, and there are machines in the market that will inform us in what time we can pull a given weight to a given height. But we have no measure that we can apply to the capacity for mental work, and no units of mental valuation. The most we can do is to compare the intellectual capacity of one man with that of another by the mental results they have severally achieved in practice. When we wish to test the fitness of a candidate for a position of trust or responsibility, we subject him to an examination, which relates, however, mostly to what he has learned, and from which we guess in a rather indirect way what he may be capable of doing in the future, and with relation to other matters than those on which we examine him; and the test is very often deceptive: for those who have made the most brilliant displays in the examination frequently fail in capacity to make practical application of what they have learned only theoretically; or they fail by irregularity, frequent and marked changes in their disposition to work, want of endurance, or too great dependence on external conditions, of which the examination gives no prediction. Such efforts as have been made to obviate this difficulty have hitherto failed to meet their object.

It has, however, recently become possible to reach fairly approximate conclusions concerning mental capacity, such as other-

wise even a long personal acquaintance with the candidate could not afford, and to determine with considerable exactness the working power of individuals in simple mental tasks. The measure is afforded by determining the number of small, similar problems resolved by the subject in a given time—such, for example, as numbering letters, reading, the learning by heart of series of numbers or syllables, and the continuous addition of columns of numbers. In the last-mentioned method the person under trial is set to adding figures ranged one under another in a book printed expressly for that purpose, for a considerable time, without stopping—under some circumstances, for several hours. When the sum reaches a hundred, the hundred is simply carried on and added to the excess in units. A bell sounds every five minutes, when the candidate draws a line after the last-added number. At the end of the trial it is easy to determine how many numbers the person can add every five minutes.

The candidates—all of nearly equal degrees of advancement, and of about the same age—varied greatly in the speed of their execution, the more rapid ones adding two and a half times as many numbers in five minutes as the slower ones. This proves that facility in reckoning is largely peculiar to the individual. Accuracy, however, was not considered. If that had been brought in, some of the results might have been materially different.

It further appeared that the speed of the additions increased regularly with each effort, but not equally with the different subjects, so that it was possible sometimes for a slower calculator eventually to pass ahead of the next quicker one. This improvement in facility was, however, subject to limitation, and is less in each repetition—as, for example, twenty-five per cent from the first trial to the second; fifteen per cent from the second to the third; and about six per cent from the third to the fourth—till a point is finally reached when there is no further increase. This capacity for improvement through practice appears also to be an individual quality. The permanence of the acquisitions obtained through it has not been sufficiently investigated; but they seem in the end gradually to wear out, and the rapidity of the wearing-out process to vary with the persons.

Of an opposite character to this is the far more rapidly increasing effect of fatigue, which always causes a diminution of efficiency, however much it may at first be temporarily balanced by the improvement through exercise. When it has once gained the upper hand, a speedy and unintermitted decline of efficiency ensues. The time when this shall take place depends on the degree of capacity already reached, the personal peculiarity, and casual influences.

The differences in the susceptibility of different persons to fatigue are very interesting. Every person, as a rule, possesses a course of efficiency peculiar to him, which works itself out in the same manner during any particular period of labor. Some display in single efforts first an increase and then after some time a decrease of efficiency; they are least readily fatigued. Others, registering a depression of efficiency after the first quarter of an hour, betray a very great susceptibility to fatigue. All the transitions are observable between these two forms, but each individual generally follows the same course according to his personal peculiarity.

The susceptibility to fatigue is observed in all possible examination tasks, and may therefore be considered to represent a bottom principle of the individual personality, which, while it may be influenced within certain limits, as a general rule measurably determines the capacity of men for work.

Other means of measuring the capacity of a subject are afforded by the ease with which he is diverted from his task, or his susceptibility to disturbing influences from without and from within; his elasticity, or the readiness with which he recovers from the effects of fatigue or diversion; and the way he is affected by taking food, physical exercise, and the time he has for sleep. In each and all of these fields of inquiry the result obtained has to be complemented finally by the estimation of the qualitative value of the work accomplished.

We may infer from this passing review that it is actually possible to express important properties of mental personality in measurable, generally comparable, determinations. But we are still far from being able to apply such measurements to the purposes of daily life. Yet, while we fail if we attempt to draw certain lessons from the matured, complicated organization of the grown-up man, the simpler, still growing mental equipment of the child affords a more fruitful field for study and is more subject to our influence.

The question then presents itself for investigation of the mental endurance of our school children. The school requires its pupils to perform daily a specified amount of mental work, while it is really not clearly known whether the childish brain is actually able to fulfill the demand without suffering lasting damage. The young men I experimented upon, whose facility in addition fell off at the beginning of the second hour, had already had their working powers exercised and tested by responding to the demand of the school and of the university. Against them was a child two years old, who gave plain evidences of weariness after only a few minutes of fixed attention. Valuable researches on this subject have been made by Prof. Burgerstein, of Vienna, who com-

posed four series of problems in addition and multiplication, the written solution of each of which would require at least ten minutes. He gave them, mostly during the earlier school hours, to pupils of different classes, between eleven and thirteen years of age, so that the pupils would have to make four calculations ten minutes long. Five minutes' pause was given between each problem and the next. The whole experiment thus lasted fifty-five minutes, or about the usual length of a school hour. One hundred and sixty-two pupils took part in the exercises, and the results were so nearly uniform that their trustworthiness can not be doubted. The first result was a notable increase of facility in the several sections of the experiment. The number of numbers counted up was about forty per cent larger in the last section than in the first. It was found, however, that not all the pupils shared equally in this advance, but that about forty-three per cent of them showed an evident sinking of efficiency at the end of the hour. The differences in personal susceptibility to fatigue previously observed among adults was also expressed here. This, however, is only a small part of the real results of the experiment. Prof. Burgerstein took pains to determine the number of mistakes committed by the pupils and the corrections they made, in order to estimate the value of the work accomplished in the several sections. Both appeared to increase from the very first, and much more rapidly than the speed of the work. It follows hence incontestably that the evidences of fatigue in the children under examination make themselves evident with increasing force from the second section of the experiment, and that in the majority of the children it is only outwardly concealed by the likewise increasing skill. The quantity of work rose, but its value underwent a constant depreciation. Similar results were obtained by the Russian Sikorski from dictation exercises, and by Höpfner in Berlin from dictations to boys nine years old.

The general result of these still too limited investigations of the susceptibility of school children to fatigue is the incontestable fact that the demands which the schools make upon the mental capacity of their pupils are far in excess of what they should be.

Yet this work is never continuous, but is interrupted by numerous pauses for rest, which doubtless have considerable influence on the progress of fatigue. The results of Burgerstein and Höpfner's experiments would have been much more unsatisfactory if brief pauses had not been interpolated between the different working spells. The remarkable fact was brought out in my experiments with adults in addition, in which pauses of ten minutes were interposed between the half-hour tasks, that the efficiency immediately after each pause was much higher than at any time before. This result is explained simply by the different velocities

with which the influence of practice and that of fatigue are lost. Fatigue passes away, comparatively very quickly, while the gain from practice, as already mentioned, is plainly demonstrable after weeks and even months. Thus it happens that with intervals of days or weeks each succeeding series of experiments begins with a quickness in calculation which is much greater than the highest achievement of the former experiment. The same takes place likewise after the short breathing pauses, as long as these pauses are sufficient to overcome in a measure the fatigue that has begun.

Since through the interpolation of pauses from work the otherwise inevitably sinking efficiency is kept at a nearly even height, the length of the periods of rest ought to be so adjusted that the injurious effects of fatigue should never acquire a predominance over the facility acquired by practice. If the experiment, however, is carried too far, the short pauses will no longer counterbalance the effect of fatigue, and the capacity to work will become null. For this reason the resting spells, if they are really to accomplish their purpose, should not only be much larger than they are now in our schools, but should succeed one another at shorter intervals and should be increased as the teaching is protracted.

The picture which we have to compose on the basis of the experiments under consideration is a gloomy one. While a quarter of an hour of simple work is enough to develop the first signs of fatigue in a twelve-year-old pupil, lessons of several hours' duration, interrupted only by a few short pauses, should soon lead to complete mental exhaustion. The demand on attention is much too long, the breathing spells are much too short, for healthy efficiency to be maintained only remotely.

The picture is, however, too darkly drawn. What I have sketched could take place only if the schools attained what they are striving for with all their means. Kind Nature has provided a safety valve for the salvation of our growing youth, the value of which can not be too highly estimated—inattention. Only by effort, and only for a short time, can we force a measurable concentration of the full force of attention upon the solution of the problem; care is therefore always taken in the school that the time of the session shall not be regarded wholly as a time of work. Burgerstein, indeed, thought that through the pauses he introduced the relation between effort and relaxation might be imitated in a regulated school hour. But these experiments seem to me to show to a certainty that our children would necessarily fall into mental disorder if they were really forced to work with full attention for forty minutes in each school hour. That, in fact, only a few are seriously injured by overwork in school is due to those interruptions to study and those incidents in teach-

ing that give the pupils happy opportunities to loosen the reins of their tired attention and forget the hard present. "One can compel children to sit and be still," says Burgerstein, "but he must not mistake; they will still in many cases take mental rest, or make a change for themselves, and not follow the course of the teaching if they are tired." Hence arises the unexpected consequence that, under the present extension of instruction, tedious teachers are a necessity.

To a certain extent the dangers of mental overwork have been recognized for a long time. All those efforts to introduce physical exercises into the school hours have in view, to a greater or less extent, the defense of the childish brain against the imminent dangers of a one-sided tension by alternating mental and muscular exertion. Gymnastic and movement exercises, manual training, and singing and drawing, to a certain extent, are intended to furnish rest-pauses for recovery from mental weariness and the gradual restoration of the previous efficiency. For this purpose such have been interposed at intervals to relieve the strictly mental work.

The physical exercises are doubtless of considerable value toward the complete building up of the personality, but they must be regarded as relaxations only within certain limits. It is, at any rate, fundamentally false to regard physical effort as in any way a suitable preparation for mental labor. Protracted experiments, pursued under my direction, have given the result that a simple walk of from one to two hours diminishes the mental efficiency in adults at least as much as about an hour's work in addition. The same is the case to a more limited extent with much less important bodily efforts. It is well known to pupils and teachers that the greater the interval of active play, the longer time is required for collecting the faculties before returning to mental work. From these experiments has arisen the demand that physical exercises should not be regarded in the plan of teaching as relaxations; and the demand for hard mental work should not be imposed on the pupil till after a rest from them.

By far the most important compensation for all effects of fatigue is sleep. Everybody, even the man mentally most inert, develops when awake a mass of mental effort which he can not afford continuously without suffering. We need, therefore, regularly recurring periods in which the consumption of mental force shall be slower than the continuous replacement. The lower the degree to which the activity of the brain sinks, then, the more rapid and more complete the recovery.

The mental vigor of most men is usually maintained at a certain height for the longest time in the forenoon. The evidences of fatigue come on later at this time of day than in the evening,

when the store of force in our brain has been already considerably drawn upon by the whole day's work. If no recovery by sleep is enjoyed, or it is imperfect, the consequences will invariably make themselves evident the next day in a depression of mental vigor as well as in a rise in the personal susceptibility to fatigue. The rapidity with which one of the persons I experimented upon could perform his tasks in addition sank about a third after a night journey by railway with insufficient sleep. Another experimenter could detect the effects of keeping himself awake all night in a gradual decrease of vigor lasting through four days. This observation was all the more surprising, because the subject was not conscious of the long duration of the disturbance, and was first made aware of it incidentally by the results of continued measurements on the causes of the manifestations of fatigue.

These experiments admonish us to give special attention to the question of sleep with men who work with their minds. This is of more especial importance for the growing generation, because the susceptibility to fatigue, and consequently the need of sleep, are much greater in the youthful brain than in that of adults. The average duration of sleep has been studied by Axel Key in Swedish pupils of different ages. He found that it ranges from nine hours in children ten years old down to seven hours in pupils of eighteen years. Children ten years old were found who slept only six, and some of seventeen or eighteen years who had to satisfy themselves with four hours!—a result which is really astonishing. Axel Key is certainly right when he assumes that the mass of Swedish school children of all ages are daily deprived of one or two hours of their needed sleep, to say nothing of those unfortunate ones who can sleep only half the time or less which is required for their healthy mental and bodily development.

The amounts of sleep required by different men are very various, for they are dependent on the deepness of the slumber. There are persons who sleep so soundly that a surprisingly short time spent in sleeping is enough for them. On the other hand, we know that for many idiosyncrasies a length of sleep which is quite enough for the average of men is much too short.

Besides sleep, which limits the waste for a certain time and favors the restoration of what has been consumed, we need for the maintenance of our working strength the assimilation of food. By means of food the substances are introduced to the tissues which they require for their constant renewal. Sleep alone can indeed retard for a long time the continued destruction of the organs by the processes of life, as it does in the hibernation of animals; but there comes a point at last when only the introduction of fresh restorative matter can assure the continued main-

tenance of the body. This necessity comes more speedily upon workingmen than on men of leisure, earlier upon children than upon mature persons. An infant at the breast could be entirely deprived of food for only a short time without serious harm, while a sound man, with other conditions favorable, can bear a privation of several days.

A time of several hours passes between the taking of food and its complete utilization in the body. During this time, especially after hearty meals, the mental vigor is diminished in a marked degree. Later it gradually rises, and the susceptibility to fatigue diminishes.

When now we look back at the conditions we have discovered that control mental vigor, we conclude that our children are exposed by the extent and arrangement of study-work in the schools to great perils for their mental and physical development. The questions that press upon us on this matter are of such importance that we all have reason to give them our full, undivided attention. We are only at the beginning of a real hygiene of mental labor, but the results we have obtained in this research, fully indicating the nature and operation of the dangers, point with equal clearness to the character of the preventive and remedial measures which should be sought and applied.

SOME BEGINNINGS IN SCIENCE.

By Prof. COLLIER COBB.

LONG before the sciences were pressing their claim to equal rank with ancient learning at Harvard, before Jefferson had seen the establishment of the University of Virginia working under the system of elective studies which he had planned, or before the magnificently endowed institutions of technology were giving what Herbert Spencer regards as knowledge of most worth, we find the beginnings of these things in the newly established university of a State that could boast of only two schools which taught more than the three R's and the very rudiments of the English language.

This modern plan of instruction offered by the University of North Carolina more than one hundred years ago was the work of a committee of six. Two of this committee were graduates of Princeton, one a graduate and ex-professor of the University of Pennsylvania, two had been students of Harvard, but their education at Cambridge had been interrupted by the Revolutionary War, and the sixth was an eminent lawyer. The names of these men were Samuel McCorkle, David Stone, Alfred Moore, Samuel

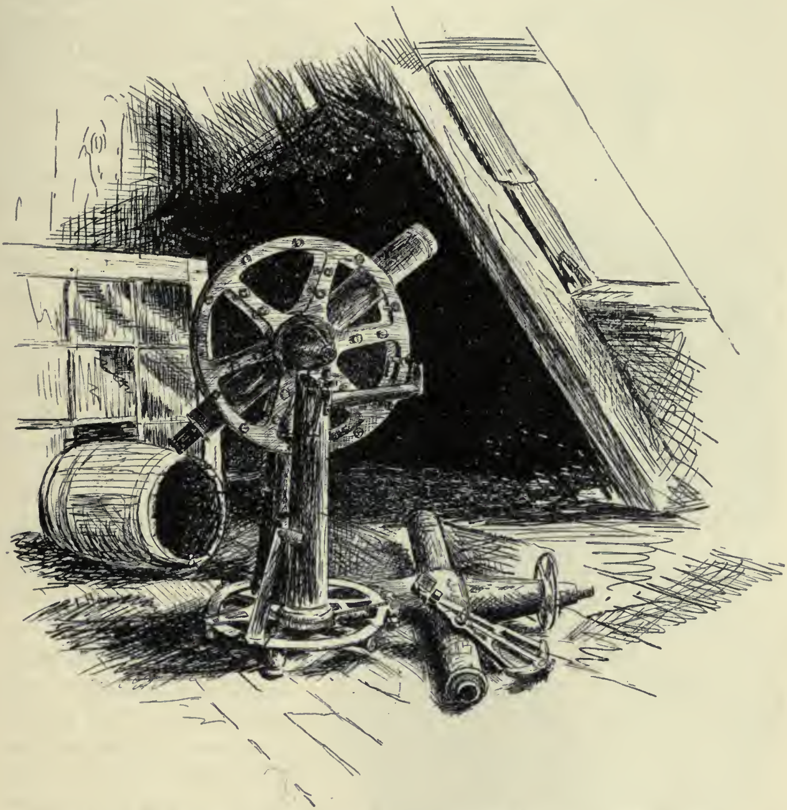
Ashe, Hugh Williamson, and John Hay. The course planned by this committee in 1792 gave great prominence to the scientific studies, especially those which could be applied to the arts. The report further recommended the purchase of apparatus for experimental philosophy and astronomy, in which must be included a set of globes, barometer, thermometer, microscope, telescope, quadrant, prismatic glass, electrical machine, and an air-pump. The ancient classics were made elective, the degree of Bachelor of Arts being obtainable without the study of either Latin or Greek. In 1800, however, Latin was made a required study, and an election allowed between French and Greek; and in 1804 Greek was added to the required studies. It is remarkable that this scheme, adopted in 1792, is almost identical with that adopted by Congress for the colleges to be formed under what is known as the Agricultural and Mechanical College Land Act of 1862. But its interest for us to-day lies in the fact that it led to the establishment of the first astronomical observatory in the United States, to the first geological survey by public authority in America, and to the first equipment for the teaching of electricity.

Joseph Caldwell.
From the collection of Hon. Kemp P. Battle.

The men chosen by the trustees to begin this work were David Ker, a graduate of Trinity College, Dublin; Charles W. Harriss, a Princeton man of the class of 1789, Professor of Mathematics; and Samuel A. Holmes, also an alumnus of Princeton. Mr. Harriss was succeeded in his professorship by Joseph Caldwell, Princeton, 1791, who was a tutor at Princeton at the time of his appointment to the professorship in North Carolina.

To Dr. Caldwell we owe the realization of the hopes of the original committee, the ultimate establishment of the observatory, the geological survey, and the electrical laboratory. A letter written by Prof. Harriss from Chapel Hill, April 10, 1795, shows something of the spirit which Dr. Caldwell was to find in the young university. In it this Princeton man says: "The constitution of this college is on a more liberal plan than that of any other in America, and by the amendments which I think it will receive at the next meeting of the trustees its usefulness will

probably be much promoted. The notion that true learning consists rather in exercising the reasoning faculties and laying up a store of useful knowledge, than in overloading the memory with words of dead languages, is becoming daily more prevalent. It is hard to deny a young gentleman the honor of a college, after he has with much labor and painful attention acquired a competent knowledge of the sciences, of composing and speak-

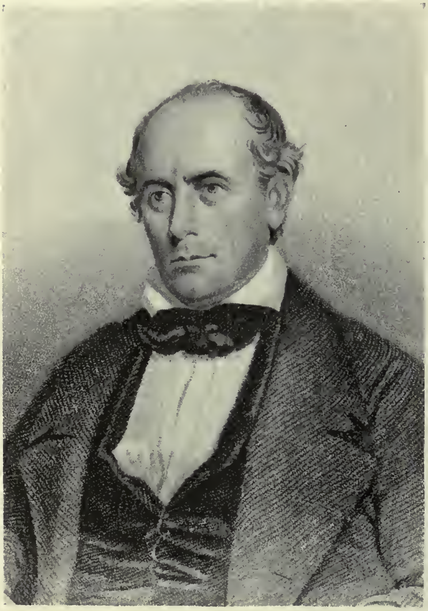


The Old Telescopes as they are To-day in the Mitchell Observatory.
Drawn by E. L. Harris.

ing with propriety in his own language, and has conned the first principles of whatever might render him useful or creditable in the world, merely because he could not read a language two thousand years old." This letter might well be dated from Boston a century later, for it was nearly a century before such ideas of the essentials of an education were gaining ground with our foremost educators. The literary societies established in 1795 took mottoes in keeping with the spirit of the day, that of the Dialectic Society being "Love of Virtue and Science," and

the motto of the Philanthropic Society, "Virtue, Liberty, and Science."

The first gift to the university, other than lands and money, came from the ladies of Raleigh and Newbern, who contributed a pair of globes, a compass, and a quadrant. The first student, Hinton James, chose as the subjects of his senior forensics, "The Uses of the Sun," "The Commerce of Britain," and "The Motions of the Earth."



Elisha Mitchell.
After portrait by Jocelyn.

The young Professor of Mathematics was made president of the university in 1804. His prosperity culminated in 1824, when the financial condition of the university was so good as to allow the trustees to send him to Europe for the purchase of scientific apparatus and books, appropriating six thousand dollars for the purpose.

Soon after his return from Europe President Caldwell planned an observatory, which he built with his own money. The building was finished in 1827, and in the observatory he placed the instruments which he had brought from Europe. These were a meridian transit telescope, made by Simms, of London; an altitude and azimuth telescope, also made by Simms; a telescope for observations on the earth and sky, made by Dolland, of London; and an astronomical clock with a mercurial pendulum, made by Molineux, of London. To these stationary instruments were added a sextant, made by Wilkinson, of London; a portable reflecting circle, made by Harris, of London; and a Hadley's quadrant.

Before the completion of the observatory building, the clock and meridian transit were set up and used in the library of the university, which was also Prof. Caldwell's lecture room. Here began, in 1825, the first systematic observations upon the heavens made in the United States. Dr. Caldwell was assisted by Profs. Mitchell and Phillips, and their first work was to find the approximate values of the longitude and the latitude of the building in which they worked. Mitchell was a Yale man of the class of

1813, a native of Connecticut, and a descendant of John Eliot, the apostle to the Indians. Phillips was an Englishman, and a son of a clergyman of the Church of England.

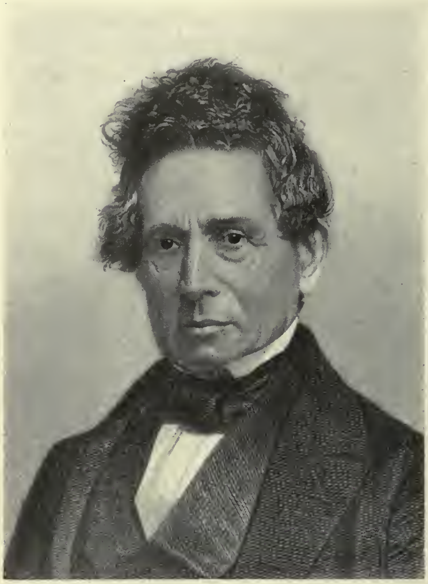
Upon its completion in 1827 the instruments were moved into the observatory, where observations were made by Dr. Caldwell and his colleagues. The materials used in the building were very poor; the bricks in the wall soon crumbled, and it became necessary, soon after the death of Dr. Caldwell, in January, 1835, to remove the instruments. The building then went rapidly to decay, and fell a victim to fire in 1838.

Observations were, however, continued by Dr. Elisha Mitchell in the attic of the large wooden building which he used as a chemical and metallurgical laboratory. In each end of the attic were two large windows, and in the roof eight others, four on either side. These observations were continued until the summer of 1857, when Prof. Mitchell lost his life upon the highest peak east of the Mississippi River, the mountain which bears his name. By his observations in 1835, 1838, 1844, and 1856 he had established the fact that the peaks of the Black Mountains in North Carolina are the highest east of the Mississippi.

James Phillips.
After portrait by W. G. Brown.

Prof. Phillips has told us that in order "to study the constellations and to show them to his pupils, Dr. Caldwell built on the top of his own residence a platform surrounded by a railing. Here he would sit night after night, pointing out to the seniors, taken in squads of three or four, the outlines of the constellations and their principal stars, and the highway of the planets and the moon. Dr. Caldwell also built in his garden, where they still stand, two pillars of brick, that their eastern and western faces, carefully ground into the same plane, might mark the true meridian. Near these pillars stood a stone pillar, some five feet high, bearing upon its top a sundial for marking the hours of the day."

Before the coming of Mitchell, Princeton thought and Princeton methods had prevailed in the University of North Carolina to the exclusion of all others. But in 1817, Denison Olmsted, a classmate of Mitchell's at Yale, was elected Professor of Chemistry and Geology. Messrs. Mitchell and Olmsted were recommended to Judge William Gaston, then a member of Congress, by the Rev. Sereno Dwight, chaplain of the United States Senate, as young men who were likely to become prominent scientists; and the trustees, upon this recommendation, and upon that of Hon. George E. Badger, who had been their classmate at Yale, offered them chairs in the university.

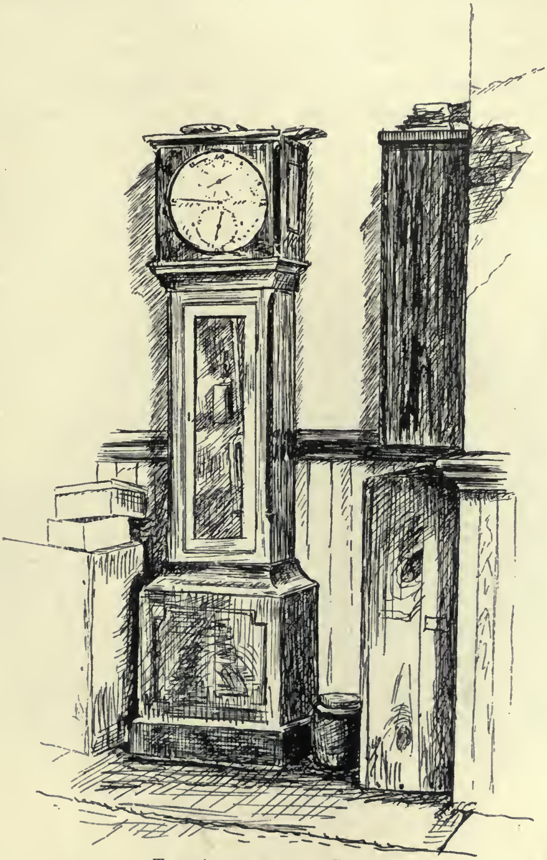


Denison Olmsted.
After a daguerreotype by Moulthrop.

In 1821 Olmsted laid before the Board of Internal Improvements of North Carolina a proposition to undertake a geological and mineralogical survey of the State. This letter is preserved in the executive office at Raleigh. The board approved, and presented the matter to the Legislature. But the Legislature took no notice of the matter until two years later, when the proposition was renewed. The survey was authorized by act of the General Assembly, ratified December 31, 1823. Prof. Olmsted was appointed to begin the survey under direction of the State Board of Agriculture, prosecuting the work during the vacations of the university. Thus was established the first geological survey by public authority in America. It was sus-

First Observatory.
Drawn from description furnished by John H. Watson, Esq., Mayor of Chapel Hill, N. C.

tained by an annual appropriation of two hundred and fifty dollars, continued for five years. When Mr. Olmsted resigned in 1825 to accept a professorship at Yale, Dr. Mitchell took up the work of the survey in addition to the duties of his professorship in the university. Olmsted's report was published in two parts, in 1824 and 1825, and filled in all about one hundred and twenty



THE ASTRONOMICAL CLOCK.
This clock still keeps the time for the university.
Drawn by E. L. Harris.

octavo pages. The American Journal of Science observes of this survey that, regarded especially as the gratuitous vacation work of a single individual, and in view of the state of geological science in this country at the time, it "must certainly be looked upon as creditable in the highest degree both to the enterprise and to the scientific ability of its projector, and it has undoubtedly been of great benefit not only to the State which authorized it, but to the country and to science generally, by

the stimulus which it afforded to similar enterprises in other States."

A few years later, in 1829, we find Dr. Caldwell purchasing of W. and S. Jones, mathematical instrument makers, London, the equipment for an electrical laboratory at the University of North Carolina. The first item on the bill, which lies before me as I write, is "a three-feet plate electrical machine with large branch conductor, supported by two glass pillars, double collectors, mounted in strong mahogany, varnished frame, with six brass legs fitted into brass sockets and screw nuts, negative brass conductor on claw-feet stand from the ground, with connecting slid-

Prof. Mitchell's Laboratory and Observatory.
After photograph by Collier Cobb.

ing tubes, brass bells and wires, etc., £45." The total amount of this first bill for electrical apparatus was £153 4*s.* 6*d.*

Dr. Caldwell published a Compendious System of Elementary Geometry, in seven books, to which an eighth is added, containing such other propositions as are elementary; subjoined is a Treatise on Plane Trigonometry. He was one of the earliest advocates in the South of popular education by the State.

Dr. Mitchell was the author of a Manual of Chemistry, a second edition of which was passing through the press at the time of his death; a Manual of Geology, illustrated by a geological map of North Carolina; a Manual of Natural History, and a Geography

of the Holy Land. Between 1830 and 1840 he contributed many valuable articles to Silliman's Journal.

Denison Olmsted became more widely known than either of the other pioneers in science. In the course of his work at Chapel Hill he gave the first geological description of the Deep River coal beds, and of the accompanying New Red sandstone, and referred the strata correctly to the same age with the Richmond coal beds and the Connecticut River sandstones. He began researches to determine the practicability of obtaining illuminating gas from cotton seed, but removed to New Haven before he had secured definite results. His Natural Philosophy, which is still a standard work, appeared in 1831, and his Astronomy, another important work, in 1839.

One wonders why such good beginnings should have borne so little fruit; but when we bear in mind that the institution which thus early fostered science had the greater part of its endowment fund swept away by the civil war, that the spirit of the South since that great event has been largely commercial and industrial, and that the income of the old university, from legislative appropriations, tuition fees, and endowment funds, is only forty-five thousand dollars, the wonder ceases.

THE VIVISECTION QUESTION.

By C. F. HODGE, Ph. D.,
ASSISTANT PROFESSOR OF PHYSIOLOGY, CLARK UNIVERSITY.

III.—THE UTILITY OF VIVISECTION.

ASIDE from the highest "use of science," its satisfaction of man's intellectual wants and its influence upon his character, science has many "practical" values connected with its development. And it is to these "uses" of physiological research that we will confine attention, bearing in mind that we are addressing those who believe that, after duty, human health and happiness are the highest values in the world, and that the greatest evils in the world, after moral evil, are human suffering caused by disease and premature death.

How much "use" humanity has for help in these regards may be seen from a glance at vital statistics. "Of 1,000,000 people starting out in life, 497,000 will die, almost all from disease, before reaching the age of forty-one."* We are losing yearly in this country over 302,806 children under five years of age.† There certainly is no "use" in this.

* Albert Buck. A Treatise on Hygiene and Public Health, vol. ii, pp. 328, 329.
† Tenth Census Compendium, p. 1707.

A recent writer* has actually cited mortality statistics to prove the futility of vivisection. The figures do show that in England since 1850 certain organic diseases have been on the increase, despite the slight advance in our knowledge of them. At first blush this table given by Leffingwell strikes one as a serious argument against the utility of research. On closer inspection, however, it only reveals the astute cunning of this author in the selection of his diseases. Almost without exception these maladies lie very deep in the hereditary tendencies of the race, and we could not expect them to be checked and reversed in so short a time. With increase of wealth and advance in civilization the chance that defectives may leave enfeebled progeny is greatly increased, and that there has not been an even greater increase in these diseases is cause for congratulation. But even if the statistics would support the significance Leffingwell attaches to them, what are we to do about it? The only courageous course would seem to be to acknowledge the extreme difficulty of the problems involved and attack them with redoubled energy. Over two thousand years of clinical observation and empiricism have probably about exhausted possibilities in these directions, so that our only hope would seem to lie in experiment; and the less preliminary experimenting on men, the better. If Leffingwell had been able to prove from statistics that there is no curable disease in the world, he would have had a strong argument. As it stands, however, it must be acknowledged to be the strongest possible argument for the side of research.

The chief point of unfairness of the table lies in Leffingwell's selection of diseases. Why confine attention to statistics of organic disease? In acute diseases, where we would naturally look for the first fruits of scientific work, the gain has been considerable.

In support of this, we may quote a few passages from Newsholme's Vital Statistics. On page 273 he says: "If these children" (the 858,878 born annually in England) "be traced through life, the changes in the death-rates occurring 1871–1880, as compared with 1838–1854, would result in an addition of 1,800,047 years of life shared among them; and since this number of births occurs annually, it may be reasonably inferred that there is an annual addition of nearly 2,000,000 years of life to the community, the greater share in which must be ascribed to sanitary measures. . . . In the decennium 1871–1880, the death-rate from fever fell from an annual average of 885 per million to 484, a decline of forty-five per cent" (page 183). For scarlet fever the decline between 1875 and 1885 was forty-nine per cent (page 185).

From tables, page 101, we see that the death-rate per 1,000 in

* Albert Leffingwell. Vivisection, p. 75, Boston, Mass., 1889 (date of introduction).

1838–'40 was, for males, 23·3; in 1887, only 19·8; for females, in 1838–'40, 22·5; in 1887, only 17·8.

From comparing death-rates for the ten years before and after 1872, the year of the passage of the Public Health Act, we find that "no less than 392,749 persons who, under the old *régime*, would have died, were, as a matter of fact, still living at the close of 1881. . . . Add to these saved lives the avoidance of at least four times as many attacks of non-fatal illness, and we have the total profits as yet received from our sanitary expenditure" (p. 127). "We may add that if the death-rates between 1881–1888 are included, the improvement becomes even more striking." Thus:

	Record of years.		Mean annual death-rate per 1,000.
Public Health Act, 1872.	Ten years,	1862–'71	22·6
	Four "	1872–'75	21·8
	Five "	1875–'80	20·79
	" "	1881–'85	19·30
		1886	19·38
		1887	18·79
		1888	17·83*
For Boston,		1892	23·3
" London,		1887	19·6
" Lowell, Mass.,		1892	26·6
" Massachusetts,		1892	20·6†

We are frequently met here by the statement that improved sanitary measures have nothing to do with vivisection. But, in order to gain the passage of costly sanitary measures, sound reasons must be given; these are drawn almost wholly from the pure sciences of physiology and hygiene, and in just those points which bear on public sanitation science owes much to experiment as an essential part. The truth of this we shall see more and more clearly as we proceed.

The most encouraging feature in the comparison of the new with the old tables of vital statistics is the decrease in child mortality. Newsholme, page 101, gives tables of annual death-rates by age-groups from 1838 to 1887. From this we see that whereas in 1838–'40, in every thousand infants born, 72·6 died under five years of age, in 1887 only 57·8 were lost—a gain of over twenty per cent. Abbreviating the table, we have, per thousand births:

AGE—	0 to 5 years.	5 to 10 years.	10 to 15 years.
1838–'40, died	72·6	9·7	5·3
1887, died	57·8	4·9	2·9
A gain of	20·5	49·5	45·2

* Arthur Newsholme. The Elements of Vital Statistics. London, 1889.

† A Summary of the Vital Statistics of the New England States for the Year 1892. Boston and London.

These things give us ground for courage and hope, but not for rest—not as long as diphtheria is annually taking from the homes of this country its 49,677 children; not while fevers are yearly "baking to death" 126,332 of our people; and while consumption is causing years of suffering and the loss annually to this country of 102,199 valuable lives.

Were this wholesale slaughter the work of a national enemy or of visible wild beasts, the public would not be slow in its appreciation of any attempt to meet the common foe. But the struggle is none the less real, and the intelligence and often the courage and self-sacrifice required to carry it on are no whit less than in the struggles of a race to subdue a savage continent or a human enemy. With the conquest of all the continental areas assured to man, if war, according to the hopes and theories of some, were a thing of the past, the next great step in the development of the race must be this conquest of the forces of disease. A comparatively small branch of the human race has come to face the issue squarely on experimental lines, and to realize the fact that success can be achieved in no other way. The fate of the Hindus stands as a warning that even an Aryan strain may lapse into the abject imbecility of zoölatry and mysticism. The race that meets this stupendous issue, that succeeds in giving to men the laws by observance of which can be attained, not only freedom from disease, but also the development of the highest type of man, that race alone can carry out to its full perfection the evolution of mankind. In course of its development this race will be able to bestow incalculable benefits upon other races and upon even the animal species which it finds useful to preserve.

IV.—THE ARGUMENT AS TO THE UTILITY OF VIVISECTION IN SPECIAL CASES.

Attempts to prove or disprove the utility of vivisection by special cases have needlessly complicated and embittered the discussion. Matters involved in the warmest medical controversy have been freely introduced, and naturally an abundance of strong language has been at the disposal of either side. It must therefore be distinctly understood as we proceed that this is not the place to settle medical controversies nor to write a complete history of useful medicine. We are to deal not with medical controversy nor with medical history, but with pure argument—argument to prove from special instances the use to humanity of vivisectional methods of investigating the processes of living Nature. This being our purpose, we must leave to experts all discussions of such things as antitoxine, hydrophobia inoculation, etc., and confine our attention to cases about which there is the

least medical controversy and about which people generally agree. We will thus select classical cases, the older the better, and only so many as will serve to render the argument clear and to illustrate best the methods of vivisectional work.

The special cases of Harvey, Charles Bell, Magendie, and Claude Bernard have come to be an established feature in every discussion of this subject, and so many wrong impressions regarding them remain uncorrected that we must consider their work at some length.

A knowledge of the circulation of the blood, no intelligent person can deny, has been of great practical value to men. It affords a foundation for all laws of hygiene and for the practice of surgery and medicine.

The first great step in the line of this discovery was made by Galen. "By ligating in a living animal an artery in two places, and opening the vessel between the ligatures, Galen demonstrated that the vessel contained blood. Thus by an experiment upon a living animal, a vivisection, the first great source of error, the supposition that the arteries contained air, was removed, the true nature of an artery demonstrated, and the modern theory of the circulation made possible." *

Whatever may be the claims of Servetus and Cæsalpinus, there can be no doubt that the one man to unite the observations of his predecessors into an intelligible whole, to found his own observations upon experiment, in short, to discover the circulation of the blood as we now understand it, was William Harvey.†

The claim is often made that Harvey discovered the circulation by "thinking," by "inductive reasoning," and not by vivisectional experiment. As well say that Columbus discovered America by thinking and not by experiment. Harvey not only thought out the circulation, which is a very small matter, but he demonstrated it to be a fact by innumerable experiments upon living animals, which is a very great matter. Here, again, we must emphasize the fact that Harvey did not study, and could

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* H. C. Chapman. History of the Discovery of the Circulation of the Blood, p. 12. Philadelphia, 1884.

† Read J. H. Baas. Outlines of the History of Medicine. New York, 1889, pp. 527–530. Also Sprengel, in his Geschichte der Arzneykunde, gives Harvey the frontispiece in vol. iv, and devotes forty pages (50–89) to his work of discovering the circulation of the blood. Also Haeser, Lehrbuch der Geschichte der Medicin, vol. ii, pp. 252–262, devotes eleven pages to "Discovery of the Circulation, Harvey." And when a man comes forward and says, "It is only our insular pride which has claimed for him the merit of the discovery," he brands himself as a person with whom it is impossible to reason (as does Lawson Tait, Uselessness of Vivisection upon Animals, p. 6). Any one desirous of investigating the trustworthiness of Tait in such matters can find him fully discussed, in a way he has not been able to answer, in the book Physiological Cruelty, by "Philanthropos," Appendix E, and also in Heidenhein, Vivisection, Leipsic, 1884, pp. 85 ff.

not possibly have studied, in dead animals "the *motion* of the heart and blood in animals." To found his great thesis on a broad basis of experiment, Harvey vivisected a great many kinds of animals, from his own person to "shrimps, snails, and shellfish."

Chapter I of Harvey's great work, De Motu Cordis et Sanguinis in Animalibus,* begins, "Cum multis vivorum dissectionibus (uti ad manum dabantur) animum ad observandum primum appuli quo cordis motus usum," etc.

Chapter II is entitled Ex vivorum dissectione, qualis sit cordis motus.

Chapter III is entitled Arteriarum motus qualis ex vivorum dissectione.

Chapter IV is entitled Motus cordis et auricularum qualis ex vivorum dissectione.

The argument that Harvey was led to his discovery by "reasoning upon the valves in the veins," as stated by Boyle, is well answered by his translator, Willis,† who points out at some length that "when we turn to Harvey himself, in his works we nowhere find that he approaches his subject from the quarter now particularly indicated" (i. e., from the purpose of the valves in the veins).

Even Harvey was attacked during his life on the ground that the discovery of the circulation was of "no use" (Willis, p. 258), "because men still continued to die."

For Harvey the blood passed through the flesh (*per partium porositates*), and not until the microscope was available was it possible for Malpighi to discover the capillary circulation in 1661. This he did in the exposed lung of a *living* frog.

In recent years Claude Bernard ‡ greatly advanced our knowledge of the circulation by demonstrating, wholly by vivisectional methods, that the flow of the blood is regulated by a nervous mechanism continuously acting to contract or dilate the vessels according to the requirements of each organ or part of the body. Thus it is seen that every important step in the advance of our knowledge of the circulation of the blood has been made by vivisection and could not possibly have been made in any other way.

Similarly, the testimony of Sir Charles Bell is constantly adduced to prove the futility of vivisection. Bell is the anatomist to whom, with Magendie and Johannes Müller, we owe the first

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* Harvei Opera, 1737, or The Motion of the Heart and Blood in Animals. Sydenham edition, London, 1847.

† Willis. William Harvey, a History of the Discovery of the Circulation of the Blood. London, 1878, pp. 301 ff.

‡ Cl. Bernard. Leçons sur le Diabète. Paris, 1877, p. 43.

great advance in the experimental study of the nervous system. He first demonstrated, though in no thoroughly satisfactory manner, the twofold function of the spinal roots. It is true that Bell did say some things derogatory of physiological experiment about the beginning of this century. But it is also true that his actions speak louder than his words. By reference to his works, we find that Bell made this great discovery in the only way possible—viz., by means of vivisectional experiments. He actually vivisected asses, kittens, rabbits, fowls, monkeys, and dogs, performing the same experiments for which Magendie has been so severely criticised.* Charles Bell was exceedingly sensitive upon the point of causing pain to animals, as is shown by several passages in his works; and it is certainly a strong argument for the necessity of vivisection that a man of his sensitive nature should be compelled to resort to this method in order to demonstrate the truth of his theories. It must be remembered that he had no anæsthetics, and therefore his position can not apply to the present discussion of the subject. Were he operating to-day, with chloroform, ether, morphine, chloral, paraldehyde, cocaine, and other anæsthetics at his disposal, he need have had no twinges of conscience about the pain his experiments occasioned.

Magendie completed Bell's work, placing it upon a firm basis by means of experiments for which he has been accused of most atrocious cruelty. It is sufficient to reply that Magendie, too, worked before anæsthetics were discovered, and when people's ideas about physical pain were very different from our ideas at present. And Magendie was, to say the least, as oblivious to his own suffering as he was to that of the animals he experimented upon. When cholera broke out in France, in 1832, he went as a volunteer into the center of the afflicted district, and afterward served in the great cholera hospital, the Hôtel Dieu, during the epidemic in Paris, and for his heroism received the cross of the Legion of Honor †—"The fiend Magendie."

Take, for example, another great line of physiological work than which few discoveries have been of more practical value to human life. Upon a knowledge of the physiology of respiration we build and ventilate, or ought to, at least, dwelling and school houses, audience rooms, and hospitals.

The first important discovery in this line was made by Sir

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* Charles Bell. Idea of a New Anatomy of the Brain. London, 1811. Transcribed by H. U. D., 1813. Also, Nervous System of the Human Body. London, 1830.

† J. C. Dalton. Magendie as a Physiologist. International Review, February, 1880, p. 120. The story of Magendie's repentance and distrust of vivisection, shortly before his death, has often been adduced against this method of research. After careful search through all the accounts of Magendie's life (thirteen in number), Dalton is able to say that there is no intimation of any ground for this idea.

Robert Boyle (1670), who found, by the use of his air pump, that if he deprived animals of air they died. He vivisected in this way kittens, birds, frogs, fish, snakes, and insects.* Boyle also discovered that by keeping animals in a closed reservoir the air became unfit to sustain life.

Priestley, a century later (1772), continued Boyle's experiments by keeping mice in air-tight receivers until the air was vitiated and would no longer support life. He then tried to restore the air to its former condition: he rarefied and condensed it, heated it, exposed it to water and earth, and treated it in many other ways, each time testing it with living mice to ascertain whether it would again support life. All this was to no effect. In every case the mice died. Finally, he found that after plants grew for a while in the vitiated air, mice could again live in it. Thus was discovered the important relation between animal and vegetable respiration, and we now plant trees and lay out parks, and call them the "lungs of our cities." Two points must be emphasized here: first, that Priestley could not have done this with dead mice; and, second, that no one except Lawson Tait and Miss Cobbe would have the hardihood to claim that he ought to have used live men instead of live mice, on grounds of moral rights, and from the fact that the physiology of man is "so different" from the physiology of the mouse.

Turning to still another important line of scientific work, diseases of microbic origin are said to cause four fifths of the sickness in the world. As an example of researches in this field, we may cite the classical work of Edward Jenner.†

Jenner began to study in earnest the disease cowpox, and its relation to smallpox, in 1775. For twenty-one years he patiently investigated the subject, and found that no one who had once suffered an attack of cowpox was taken with smallpox, although frequently exposed. "Legends of the dairymaids" had told for generations that an attack of cowpox conferred exemption from smallpox forever after. Jenner might have told the same story; but, if he had not proved the truth of his assertion by experiment, we might still have nothing but "legends of dairymaids" and no vaccination.

In May of 1796 Jenner began his experiments. He says (page 29): "The more accurately to observe the progress of the infection, I selected a healthy boy, about eight years of age, for the purpose of inoculation for the cowpox." This inoculation was followed by an attack of the disease. But Jenner does not

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* Boyle. Philosophical Transactions, vol. v, pp. 2011–2055.

† Edward Jenner. An Inquiry into the Causes and Effects of the Variolæ Vaccinæ, December 20, 1799. London, 1801.

stop here. Again, he says: "In order to ascertain whether the boy was secure from the contagion of the smallpox, he was inoculated the 1st of July following with variolous matter immediately taken from a pustule. Several punctures were made in both arms, and the matter was carefully inserted, but no disease followed."

Some might have called the discovery complete at this point, but Jenner realized that one case is not every case, and that he must repeat the experiment, which he did scores of times, even going so far as to endanger human life in order to establish the truth of his discovery. For he goes on to say (page 41): "To convince myself that the variolous matter made use of was in a perfect state, I [at the same time that he inoculated a patient previously inoculated with cowpox] inoculated a patient with some of it who had never gone through the cowpox, and it produced the smallpox in the usual regular manner."

Previous to the introduction of vaccination in London the average annual death-rate per million from smallpox was (Newsholme, table, page 192):

1728–'57	4,260	
1771–'80	5,020	
1801–'10	2,040	beginning of Jenner's work.
1872–'82	262	
1885	1,419	
1886	24	
1887	9	

Germany now has the most efficient laws of probably any country for making not only vaccination but repetition at stated intervals obligatory. As a result smallpox is rapidly disappearing. In 1888 the deaths from smallpox in the entire empire amounted to one hundred and ten, less than 2·5 per million, and the majority of these occurred on or near the boundaries of other countries. We can easily appreciate the usefulness of this. Still, during this work Jenner was persecuted and abused.

Jenner's experiments belong to the class of investigations which since 1850 Thiersch has made for cholera, Lister for inflammation of wounds, Pasteur for rabies, Koch and Pasteur for splenic fever, M. Freire for yellow fever, Koch later for cholera, and has now begun to make for consumption.

Thiersch's experiments on cholera, which caused the death of fourteen mice and proved that cholera is communicated by swallowing particles of cholera discharge, have been an important factor in the sanitary legislation of every civilized country.

Two of the London water companies experimented with cholera-polluted water upon 500,000 people, causing the death of 3,476 human beings in 1853–'54. This is the popular accidental

experiment which antivivisection writers tell us to wait for, and which they say is sent by Providence to teach men physiology. Thiersch made the same experiment upon fifty-six mice, the conditions being accurately determined and scientifically controlled, and with the death of fourteen mice gave the world more exact information about the contagion of cholera than all the cholera epidemics recorded in history. This is the scientific experiment which we are told should not be made.*

The antiseptic method, which we owe in so great a measure to the vivisectional experiments of Joseph Lister, is past all reasonable controversy and we may refer to it here. It has come to be used in hospitals generally, and has reduced mortality from surgical operations to one tenth of what it was before. Any one who has seen even a few cases of antiseptic surgery will readily agree with Dr. Keen when he says: "Sir Joseph Lister has done more to save human life and diminish human suffering than any other man of the last fifty years." † Still, Lister was obliged to leave England to continue experiment in his merciful work after the passage of the restrictive law in 1876.

In the Tübingen Hospital died from amputation before introduction of Lister's method and after:

	Per cent.	Per cent.
Of lower limb	43·5	3·2
Of upper limb	30·6	2·9 ‡

We might extend much further the list of useful discoveries which have depended for some essential part of their development upon vivisectional experiment; but such is not our present purpose. The reader can find these amply discussed elsewhere. We would, however, at this point call special attention to the way in which a discovery of this kind is received. Jenner's smallpox inoculation was obliged to run the same gantlet of popular and professional favor and disfavor as Lister's discovery, as Koch's and Pasteur's are running now. Such discoveries are in even greater danger from ignorant and enthusiastic supporters than from learned opponents. The problems involved are very complicated. Exceptions of every kind occur—e. g., a person may have smallpox twice, and so, although vaccination protects in most cases, it does not in all; and, further, as Jenner himself says, "inoculation sometimes under the best management proves fatal." #

In the case of one of these complications in London, Jenner

* John Simon. Experiments on Life. London, 1881.

† W. W. Keen. Our Debts to Vivisection. Reprint from Popular Science Monthly, May, 1885, p. 15.

‡ Heidenhain. Die Vivisection, p. 34.

Jenner, *loc. cit.*, p. 57.

has himself left a record in strong English of the way he felt. Writing to Moore in 1811 he says: "The town is a fool, an idiot, and will continue in this red-hot, hissing-hot state about this affair until something else starts up to draw aside its attention. I am determined to lock up my brains and think no more *pro bono publico*, and I advise you, my friend, to do the same, for we are sure to get nothing but abuse for it." *

We are, however, discussing the utility of a method, and while we will not introduce Koch's treatment as an argument for the utility of vivisection until it has been perfected and the medical profession has reached a decision as to its value, we can hardly find a better example of the vivisectional method. Koch's method is that of Jenner perfected by using animals instead of men. His discovery in 1882 of the tubercle bacillus has already become of inestimable value in directing sanitary measures and in recognizing the earlier stages of consumption while cure is possible. This, we are told by an antivivisection writer, "was discovered by the microscope, not by vivisection." † How did Koch make this discovery?

It is true the microscope assisted as spectacles help to read. But Koch, in the examination of tuberculous matter, discovered a number of germs with the microscope. Which one of these caused consumption no number of microscopes could tell him. This had to be settled by most careful experiments. There are several steps in the process. The first is to identify all the different kinds of microbes found constantly in tuberculous bodies. For convenience we will call these microbes *a, b, c, d*. These are mingled together. The second step is to cultivate these germs in one test tube after another until perfectly "pure cultures" are obtained—i. e., nothing but *a's* in one, nothing but *b's* in another, and so on. Up to this stage he has not the least idea which of these is the germ of consumption. The only way he can determine this point is by experimenting upon living animals. He must then inoculate a number of healthy animals, one with germ *a*, another with germ *b*, another with germ *c*, another with germ *d*. The four animals are now watched carefully. The animal inoculated with germ *a*, we will say, sickens and dies with unmistakable symptoms of tuberculosis. Those inoculated with germs *b*, *c*, and *d* are not affected. He repeats the experiment several times, and if each time with the same result is justified in concluding that germ *a* is the cause of tuberculosis, while the other germs are harmless.

This is but the first stage in the investigation. After the dis-

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* Crookshank, *op. cit.*, fol. i, p. 139.

† Ernest Bell, M. A. Weighed and Found Wanting, Victoria St. Society publication.

covery of the cause comes the question, How can this cause be controlled? How can its action be prevented? Here, as Koch says, men have begun at the wrong end of the problem. Since the beginning of medicine the doctors have been experimenting upon men to find a cure for consumption. The problem here is too complicated, and in consequence little has been learned. Experiment must begin, he says, with the bacillus itself. We must grow it first in pure cultures in test tubes, in all manner of different culture media and under all conditions of temperature and light, in order to ascertain under what conditions it grows best and under what conditions it can not grow. We must next subject it in the test tube to the influence of different chemical substances, and when some compound is discovered to kill or hinder the growth of the bacillus in the culture, then the substance must be tried upon tuberculous animals to ascertain whether in their bodies as in the test tube it will act to kill the bacilli without injuring the animal. When a substance fatal to the bacillus and harmless to the animal is found, with all due allowance for differences between the animal and man, it may be tested on man.

This, in brief, is but one important line of research, and clearly it should be carried out thoroughly for every infectious disease. A single link in the chain of procedure requires absolutely to be welded by experiments upon living animals. With millions on millions of human beings and animals suffering and dying yearly for lack of this knowledge, no truly humane person can for a moment deny to an investigator the right to complete his work by introducing this link.

In view of the stupendous values involved it is clear that any amount necessary of animal or human sacrifice and suffering is wholly justified. Whether unnecessary suffering is inflicted is a question which only the highest experts can adequately decide. Prof. Bowditch * has so thoroughly discussed the subject of pain caused by vivisection that we would pass it by without mention, were it not for the fact that the public mind has been of late so much abused by misstatement and exaggeration on this head. Prof. Yeo's estimate, the most reliable we have, is that in every one hundred experiments seventy-five are "absolutely painless," twenty are as "painful as vaccination," four, as "painful as the healing of a wound," one, as "painful as a surgical operation." The pain of vaccination is altogether trifling, and that of the healing of a wound after antiseptic treatment is also practically nil. This leaves but one per cent of all experiments as painful to any serious degree. During over ten years' active experience in

* H. P. Bowditch. The Advancement of Medicine by Research. Science, July 24, 1896.

three laboratories in this country and a number of the leading laboratories abroad, I have never had occasion to perform or witness an experiment of this painful class. Discovery of new anæsthetics and more recent methods of operation have doubtless reduced the pain of experimentation even below Yeo's estimate. In all laboratories in this country, and equally abroad, I have always found anæsthetics adequately and uniformly employed.

In the recent discussions before the House Judiciary Committee of Massachusetts upon the bill relating to inspection of vivisectional experiments in the medical schools and universities of the State, none of the petitioners for the bill were able to cite a single case, or the reasonable suspicion of a case, of abuse of vivisection, as having occurred within the State of Massachusetts. In order to obtain as reliable data as possible upon this point, I sent blank tables, arranged according to the table below, to all the laboratories in Massachusetts where vivisectional experiments were likely to be made. Returns were kindly sent in from all the laboratories, and may safely be taken to represent the experimental work in the State during the year 1894–'95.

ANIMAL.	Number used.	Painless.	PAINFUL AS			
			Vaccination.	Healing of wound.	Effect of poison.	Disease.
Frogs..........	866	845	4	..	17	...
Pigeons........	23	19	..	4	..	...
Rats...........	25	25	..	..	..	...
Rabbits........	146	61	50	..	5	30
Guinea-pigs.....	465	..	150	..	..	315
Cats...........	22	18	..	..	4	...
Dogs...........	95	91	..	2	2	...
Mice...........	30	10	..	..	..	20
Squirrels.......	3	3	..	..	..	...
Totals.......	1,675	1,072 (64%)	204 (12·2%)	6 (0·4%)	28 (1·6%)	365 (21·8%)

Contrast with this the 34,419 human beings who die of disease annually in Massachusetts.

A general principle underlying vivisectional work is also revealed in the table, viz., that the lowest animal adequate for the purposes of the research be employed in preference to one more highly organized. This entirely negatives an assumption often advanced that animal vivisection tends toward human vivisection. The whole tendency of modern physiology has been exactly the reverse. Animals have come to be used in order to save human beings from abuse.* In the very beginning of medicine

* The recent action of Dr. J. S. Pyle (A Plea for the Appropriation of Criminals condemned to Capital Punishment to the Experimental Physiologist, Canton, Ohio, 1893), so

every attempt to cure disease or alleviate suffering must have been, in the nature of the case, an act of human vivisection. A large proportion of modern medicine at present is equally in essence nothing more nor less than human vivisection, and it is only gradually, as elements of experiment and uncertainty are eliminated from remedial measures by more exact knowledge, that the practice of medicine becomes anything more than human vivisection.*

A further argument against the utility of animal experimentation is based on differences between animals and men, which make it unsafe to apply results directly from the animal to man. A logical error is here involved; for, while there are physiological differences between different animals, to one point of difference there are many points of close similarity. A difference in physiological function is technically known as an idiosyncrasy. These differences exist between individual men as well as between different species of animals. A man who has had smallpox or measles acquires an idiosyncrasy which protects him from having them again. In some cases this difference exists from birth; in others it is impossible to acquire it. Man himself begins life as a microscopical speck of living matter, and in his physical development passes through and beyond the lower stages of organic life. Hence the fundamental physiological processes and functions he has in common with the great body of living things beneath him. On this wider view physiological idiosyncrasy becomes the strongest possible incentive to experiment. How is it that certain species have become wholly immune from certain diseases? With the secret of this immunity discovered, it may be easy to induce a similar immunity in another species or in man.

The conclusion which follows from the foregoing chapters bears directly upon a topic of considerable present importance, viz., that of legislative interference with scientific work.† With due appreciation of scientific achievements in the past, we must keep ever before us the fact that the hardest labors and richest harvests in science are still in the future. And every consideration of religion, morality, altruism, humanity, and utility urge to

far as I have been able to ascertain, is an individual matter, and can not be taken to represent in the slightest degree the tendency of experimental medicine or the attitude of experimental physiologists in this country.

* The Zend-Avesta permitted a doctor to practice his art upon three heretics. If these all died or were made worse by his treatment, he was forbidden, on penalty of death, to follow his profession further. If they recovered, he might begin practice upon the faithful.—Sprengel. Geschichte der Arzneykunde, vol. i, p. 126. (Refers to Zend-Avesta, Part III, p. 336.)

† For fuller discussion of this topic see Bowditch, *loc. cit.*, pp. 8–16, and appendix.

the prosecution of physiological education and research with unabated energy. Hence no legislative action should be taken which could possibly offer hindrance or annoyance to either teachers or investigators.

In accordance with the pernicious principle that a law can do no harm except to offenders, the English Parliament, in 1876, passed an act severely restricting vivisectional work. This action of England was promptly reversed by every other European nation where the subject was agitated, and by every State Legislature in this country to which the matter has been referred. Within the past year this reversal has been reaffirmed in Switzerland and in Massachusetts. The restrictive act in England served not in the least to abate the agitation and protect physiologists in their work, as was intended; but, as an eminent English physiologist puts it, has "only tended to encourage the opponents of science in their vexatious interference." English antivivisectionists under this encouragement have shifted position from restriction to total abolition, and have increased the agitation. We have in this country at least three societies organized on the platform of total abolition of physiological experiments. The legislative measures advanced thus far by these organizations have been mild in the main; but while they emphasize before the public the fact that their laws do not aim to "prohibit" experiments, they are also unguarded enough to speak of them as "the entering wedge for more radical measures in the future." * Clearly, for medical and scientific faculties, for medical societies, and for all who have at heart the advancement of humanity and science, the strategic point at which to meet the enemy is the point of "the entering wedge."

After conscientiously reading their literature for the past five years I feel warranted in saying that science has little to fear from the efforts of the antivivisection societies. Their methods of agitation would sink even a worthy cause. The real danger lies with scientific men themselves who entertain ideas of conciliation and compromise which will admit the point of the "entering wedge." Prof. Michael Foster has had the benefit of twenty years' experience in conducting a laboratory under restrictive legislation, and his advice should certainly carry great weight. He writes as follows: "My earnest advice" (to us in America) "is to straighten your backs, and, knowing that no legislation is necessary on grounds of humanity, and that all legislation is bad for science, strain every effort to defeat the agitation." †

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* Antivivisection, June, 1896, pp. 9 and 13. Aurora, Ill.

† Private letter from Prof. Foster to the writer, under date of February 1, 1896.

ACETYLENE, THE NEW ILLUMINANT.

By V. J. YOUMANS.

THE advent of the electric light, the Siemens-Lungren regenerative burner, and the Welsbach incandescent mantle, all within a comparatively short period, threw the lighting industry into a very unsettled condition. There had begun, however, to appear some order out of the chaos. As the special advantages of the different systems were recognized, the purposes to which each was best adapted were noted. The development of the industries was going on very satisfactorily, when a new competitor appeared in the shape of acetylene. It is now stated that Mr. Edison and Nikola Tesla are independently working out still another system, based on the vacuum-tube phenomena; a subject in which Mr. D. McFarlan Moore claims also to have made a great step in advance by the invention of his vacuum vibrator. Vacuum-tube lighting, however, is still in the laboratory, and, while surprising tales are told of its great beauty and high efficiency, it is too soon to even prophesy intelligently regarding it. Acetylene has, however, during the last few years been much discussed, and considerable data are available regarding it; so that an inquiry into its history and value as a practical illuminant is of interest.

Acetylene (C_2H_2) was first described by Edmund Davy, who obtained it accidentally by the action of water on a mass of carbonized tartar and charcoal powder, with which he had attempted to prepare potassium. He called the new gas *klumene.* Some years later it was rediscovered by Berthelot, who obtained it by passing ethylene through a red-hot tube; he noted its occurrence in coal gas, and later succeeded in making it by passing a powerful electric current between two carbon poles in an atmosphere of hydrogen.

The resulting mixture of acetylene and hydrogen was passed into an ammoniacal solution of cuprous chloride, and the insoluble copper compound thus obtained, which is extremely explosive and has recently caused several serious accidents, was then treated with hydrochloric acid, which liberated acetylene.

Acetylene is a colorless gas, having a rather disagreeable odor, somewhat resembling garlic and phosphorus. The peculiar odor noticed when the burners of a gas stove strike back is due to the formation of acetylene. Its specific gravity when compared with air is 0·91 (ordinary coal gas has a specific gravity of about 0·607). At 0°, and under a pressure of 21·5 atmospheres (322·5 pounds per square inch), it becomes a mobile, highly refractive liquid. Water at 18° dissolves its own volume of the gas. When ignited at an ordinary burner it gives a smoky, dull flame, and with oxygen

forms an explosive mixture, as it does also when mixed in certain proportions with air; but when burned through a very small tip and under slight pressure, or when mixed with coal gas or air in proper proportions, an exceedingly brilliant and highly luminous flame is produced. Acetylene is poisonous, combining with the hæmoglobin of the blood, to the exclusion of oxygen, to form a compound similar to that yielded by carbon monoxide. Moissan, however, reports that when prepared from pure calcium carbide, and after being purified by liquefaction, it has an ethereal odor, and can be breathed in small quantities without evil effects. Regarding its explosiveness Mr. J. M. Crafts says: "Experiments, using a two-inch gas pipe as a cannon, show that from five to six per cent of acetylene mixed with air forms an explosive mixture. . . . About ten per cent of water gas is necessary before an explosive mixture with air is formed." Explosive mixtures in the air of a room would be produced by much smaller percentages than these. Lechattelier gives 2·8 per cent acetylene mixed with air as an explosive compound. So far as its poisonous qualities are concerned, acetylene seems to have a little the advantage of water gas; the poisonous principle of the latter is carbon monoxide, whose combination with the blood is somewhat more energetic than that of acetylene, and which has no odor to serve as a warning in case of a leak, as has acetylene. Acetylene is, however, more prone to form explosive mixtures. This is due to the fact that in the combination of carbon and hydrogen to form acetylene 61·100 units of heat are absorbed. Thus the heating power of a cubic foot of acetylene is sufficient to raise 407 kilogrammes (a kilogramme = 2·2 pounds) of water 1° C. The combustion of the same amounts of uncombined carbon and hydrogen as are present in a cubic foot of acetylene will raise only 336·5 kilogrammes of water to 1° C., leaving a difference in favor of acetylene of 70·5 heat units—the unit being the amount of heat required to raise the temperature of one kilogramme of water 1° C.

Acetylene is one of the important bodies, much used by the chemist in the synthesis of organic compounds. It is also reported to be of value in polariscope work, permitting the reading of solutions so highly colored as to be opaque to the ordinary sources of light. Some interesting experiments with the gas in abnormal physical states were recently performed by J. J. Suckert, during a lecture before the Franklin Institute. A tube of liquefied acetylene was cooled to −28° F., and then the pressure removed. Rapid evaporation took place, and a portion of the liquid gas was solidified into a snowlike mass whose temperature was found to be −118° F. A part of this snow placed on some mercury in a saucer soon froze the latter, and another portion, on being dropped into water, upon which it floated, gave off acetylene

gas, which was readily ignited and burned with its characteristic sooty flame.

Regarding the illuminating power of acetylene, a proper burner using five cubic feet per hour will give from two hundred to two hundred and forty candle power. Five cubic feet of ordinary gas give from fifteen to thirty candle power; that is, a cubic foot of acetylene will give about eight times as much light as the same amount of coal or water gas. Indeed, it is claimed by Prof. Lewes and others that the formation of acetylene in the ordinary gas flame accounts for the latter's luminosity, and it has been proposed to enrich water gas by the addition of a small amount of acetylene; but so much of the latter was found necessary to produce any appreciable result as to render the process impracticable. Acetylene requires a much larger amount of air for complete combustion than does ordinary gas. This is a distinct disadvantage, as the large amount of air cools the flame, and thus diminishes its luminosity. The temperature of the acetylene flame is about 1000° C., that of an ordinary flat coal-gas flame being 1360° C.

The present rise into prominence of acetylene, which up to 1888 was simply a laboratory product, is due to the discovery of the formation of calcium carbide in the electric furnace. There is some controversy as to who first made this discovery, but the honors seem to belong to Mr. T. L. Wilson, of the Wilson Aluminum Works. In 1888 Mr. Wilson began a series of experiments with the electric furnace for reducing refractory ores; during one of these a curious, dark-brown, dense mass was formed, whose immersion in water produced a violent evolution of gas, which upon investigation proved to be acetylene. A French chemist, Moissan, independently discovered the process, and reported it at the meeting of the French Academy, in December, 1892. But as Mr. Wilson sent samples of the carbide to Lord Kelvin in the summer of 1892, for examination, he seems to have preceded Moissan, at any rate in announcing his discovery. All the alkaline earths form carbides in a similar way, which, when treated with water, give off acetylene. It may be interesting to note, in passing, that by means of the electric furnace, a carbide of silicon has recently been obtained, which under the name of carborundum is coming to be used extensively as a polishing and grinding material. It is extremely hard (scratching rubies) and is said to wear well. Another interesting product is the carbide of titanium, the hardness of which is sufficient to scratch the diamond. This discovery of the ready formation of carbides under the great heat of the electric furnace is of special interest to the geologist, as bearing on the theory that these carbides are present in large quantities in the interior regions, to which water must occasionally penetrate; the resulting generation of gases

and production of high pressures and heat accounting for the various volcanic disturbances and the large natural deposits of petroleum and other carbonaceous material, which occur so abundantly in some districts.

Pure calcium carbide has a specific gravity of 2·262; in a dry atmosphere it is odorless, but upon exposure to moisture evolves the peculiar odor of acetylene. When exposed in lumps to the action of ordinary air it becomes coated with a layer of hydrate of lime, which protects the interior of the mass from further oxidation. It is not inflammable, and can be exposed to the heat of the ordinary blast furnace without decomposition. It is, in fact, a very stable compound, its ready decomposition under the action of water being quite at variance with its other chemical properties. It was first prepared by Woehler, in 1862, by fusing an alloy of zinc and calcium with carbon. He called it acetylene carbide. It forms a dark grayish or red dense mass, which upon fracture shows a crystalline metallic surface. The whole process of manufacturing acetylene, from the preparation of the lime and coke onward, is very simple, and the only reason why it is new as a commercial product is the difficulty of causing a combination between the calcium of the lime and the carbon of the coke. Nothing short of the temperature of the electric furnace (3500° to 4000° C.) will bring this about, and the comparative modernness of this apparatus accounts for the lateness of the calcium carbide. The chemistry of the process is as follows: Quicklime (CaO) and coke, or any other substance whose main content is carbon (C), are mixed and fused together in the electric furnace. The calcium (Ca) of the lime combines with part of the carbon (C) of the coke to form calcium carbide (CaC_2); the oxygen (O) of the quicklime combining with another portion of the carbon to form carbonic oxide:

$$\underset{\text{Quicklime.}}{CaO} + \underset{\text{Coke.}}{3C} = \underset{\text{Calcium carbide.}}{CaC_2} + \underset{\text{Carbonic oxide.}}{CO}$$

Carbonic oxide is a gas and is driven off, leaving calcium carbide and the various impurities in the furnace. The further reaction to form acetylene occurs when calcium carbide is subjected to the action of water:

$$\underset{\text{Calcium carbide.}}{CaC_2} + \underset{\text{Water.}}{2(H_2O)} = \underset{\text{Slaked lime.}}{Ca(OH)_2} + \underset{\text{Acetylene.}}{C_2H_2}$$

The following description of the commercial manufacture of calcium carbide as conducted at Spray is based on a paper by G. de Chalmot, who for some time had personal supervision of the works of the Wilson Aluminum Company at Spray, N. C., and

an address by W. R. Addicks, of Boston, Mass., delivered before the New England Association of Gas Engineers at their twenty-sixth annual meeting:

The electric furnace is of ordinary brick, two and a half by three feet (inside measurements) at the bottom. The front side consists of four iron doors. The electric current enters at the bottom and top; the lower electrode is an iron plate covered with eight inches of carbon (pieces of carbon pencils or a mixture of coke and coal tar). Sixteen copper cables 0·75 inch in diameter convey the electricity from the dynamos to the bottom electrode; sixteen other cables are connected with the top electrode, which is composed of six carbon pencils each four inches square and thirty-six inches long; these are bound together by a sheet of iron, so as to really form only one pencil. The upper electrode is so arranged that it can be raised or lowered by means of a screw. Dynamos giving a current of from fifty to one hundred volts and seventeen hundred to two thousand ampères are used, actuated by a water wheel of three hundred horse-power capacity. To start the furnace a little carefully ground and mixed lime and coke (this being done by special grinding and mixing machinery, which forms an essential part of the plant) is thrown on the bottom of the furnace, the current turned on, and the upper electrode lowered until an arc is formed between it and the mixture. The carbide soon begins to form, and new material is shoveled in as the ingot is built up. The end of the pencil is kept covered with about a foot of the mixture, and is gradually raised by the attendant until the capacity of the furnace is reached; then the current is turned off and the furnace left to cool. This constitutes the whole process, and is extremely simple and inexpensive, requiring no skilled labor and little machinery. Much time has been lost at Spray in waiting for the furnace to cool, which requires from four to eight hours. In the new plant of the Philadelphia company at Niagara the lower electrode and the bottom of the furnace consist of a car, which, as soon as the run is finished, can be drawn out and a fresh car substituted, thus obviating the loss of time and heat in waiting for the furnace to cool. Many other improvements, including an arrangement by which the mixed lime and coke are automatically fed into the furnace, are expected to materially reduce the cost of manufacture at the Niagara works.

The proportions of lime and coke are roughly calculated by means of the atomic weights involved in the reaction, but in practice it is found that, owing to impurities and loss in the process, these amounts have to be exceeded somewhat. After the mass in the furnace has cooled sufficiently, it is dumped on a grate which holds the carbide and permits the unreduced material, amount-

ing to from fifty to seventy-five per cent of the original mass, to fall through into a bin, from which it is collected to be used again. The lime requires to be fairly pure, over five per cent of impurities interfering seriously with the production of carbide. Magnesia is very undesirable, and it is stated that if over three per cent is present a good quality of carbide can not be made. This matter of impurities and the care of the carbon pencils, which when properly looked after wear away only about 0·09 of an inch per hour, but which may make a great deal of trouble if carelessly tended, are the points requiring special attention. Unslaked lime is said to give the best results. The alternating current is used at Spray, but a direct current can be employed. Besides coke, soft coal, anthracite, charcoal, pitch, tar, resin, and asphalt have been tried in combination with lime. Indeed, the first mixture used by Mr. Wilson was lime and tar, which had been boiled together in a caldron and then thoroughly dried. With the exception of charcoal, however, none of these substances were found of any value as compared with coke, although they all produced some carbide. As regards the amount and quality of the light obtained from acetylene properly burned, there seems no question as to its great superiority over either ordinary coal or water gas. It stands about even with water gas in poisonous qualities, but is more liable to explosion. Greater care would be required in handling it, especially if the proposition, which was at first well received, to use it in a liquefied state from cylinders under great pressure, should prove practicable.

Its success as an illuminant, however, depends almost entirely on the cost of manufacture, and regarding this point it is somewhat difficult at present to get reliable data, chiefly, perhaps, because of the experimental stage in which much of the apparatus still is.

The Progressive Age, a New York publication devoted to the interests of electricity, gas, and water, recently formed a commission which it sent down to Spray for the purpose of determining the actual cost of manufacturing calcium carbide. The commissioners were Prof. Houston and Drs. Kennelly and Kinnicutt, and their conclusions, after careful examination of the works and a testing of two full runs, were published in the Progressive Age for April 15th, and are as follows:

"Our estimate, therefore, of the cost of producing calcium carbide at Spray, by working the furnaces three hundred and sixty-five days a year and twenty-four hours a day, yielding on the average one ton of two thousand pounds gross carbide a day, is $32.76 per ton. Of this amount $14.39 is for material. The freight charges on lime and coke are heavy at Spray, and add materially to the cost."

They found an average net yield of acetylene of 4·926 cubic feet of moist gas per pound of net carbide, or 4·696 cubic feet per pound of gross carbide. A gross ton of carbide, then, will yield about 9,400 cubic feet of acetylene at a cost very slightly above $32.76, as the final formation of acetylene is practically without expense. Nine thousand four hundred cubic feet of coal or water gas costs the consumer somewhere between fourteen and sixteen dollars, roughly about one half as much as the same amount of acetylene. But as acetylene gives over eight times as much light per cubic foot, a large margin seems to be left for decreased gas bills to the consumer and increased profit for the producer. On the whole, then, it may be said that acetylene promises to be an important rival of the present methods of illumination, and deserves the careful examination of both the consumer and manufacturer of light-givers.

It has been proposed to use calcium carbide as a concentrated fuel on war vessels and in places where space is of more importance than cost. Dr. Frank has made the following calculation of the gain in space over coal: To provide power for a one-thousand-horse marine engine for twenty-five days would require four hundred and thirteen tons of coal, occupying a space of about fifteen hundred cubic feet. In this space could be stored enough of the carbide to propel the ship at the same rate for seventy-five days. In other words, as a fuel one ton of carbide is equal to three tons of coal. There are works engaged in the manufacture of calcium carbide at Spray, N. C., at Niagara Falls and at Lockport, N. Y.; in Europe, at Betterfeld, Prussia, at Neuhausen, Switzerland, at Baden, in Germany, and at Troyes and Vallorbes, in France.

The native Micronesian population of the Marshall Islands is represented by Dr. Steinbach to be rather increasing than decreasing—a census on one of the islands showing an increase of about fifteen per thousand a year. The density is about sixty-eight to the mile. The people are divided into four sharply defined classes : the common people, or Kayur ; the next higher class, the Leataketak, comparable with the village magistrates in Germany, who see that the orders of the chief are carried out ; the ordinary chiefs, Burak ; and the Iroj, or head chiefs. Neither of the two lower classes own land, but they are allowed to grow as much produce or catch as much fish as is necessary for their sustenance ; and they have to perform certain services for the chiefs. The ordinary chiefs often possess larger holdings than the Iroj, or head chiefs. All the members of the four classes acquire their rank through the mother only. The son of a woman of the Iroj class is always an Iroj, even though the father be a common Kayur. The chiefs have still considerable dignity and power, including that of life and death.

THE SIGNIFICANCE OF LEAVES.

BY F. SCHUYLER MATHEWS.

WHILE we admire and enjoy the greenness and the general effect of foliage, and regard the forms of single trees if they are particularly graceful or otherwise peculiar in shape, we seldom give special attention to individual leaves, but are rather inclined to neglect them as common and trivial. Yet, as Mr. F. Schuyler Mathews * well says, while they may be common, "they are far from commonplace. If we doubt this, let us try to draw or paint a single leaf. Only a great artist can depict *all* of some *one* of its manifold truths; one may draw ever so carefully and

FIG. 1.—WHITE PINE, LEAF AT A.

well, yet he can not tell with the pencil or the brush all the truth and beauty of one leaf. Its color is too waxen and pure to be imitated by earthy pigments; its outline is too subtile, its teeth are too finely and vigorously formed, and its veins are too infinitely complex for one to copy with absolute, lifelike accuracy. No, it is not possible to portray all the beauty of a leaf with the pencil. Yet this work of Nature's wonderful art is common: the

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* Familiar Trees and their Leaves. By F. Schuyler Mathews. With an Introduction by Prof. L. H. Bailey. Published by D. Appleton & Co.

world is filled with untold billions of leaves, no two of which are exactly alike. "It is undoubtedly the fact that we do not fully appreciate either the beauty or the usefulness of trees; but after

Fig. 2.—Catalpa Leaf.

we have become really familiar with them, and have learned readily to distinguish the different species, we find ourselves in a new world of absorbing interest, in which beauty and use have expanded to proportions far beyond our previous conceptions."

Many pleasant and profitable lessons can be learned from Mr. Mathews's two hundred and odd sketches of leaves taken from Nature, with their accompanying brief descriptions. The single lesson to which we would here call attention is the variety in the forms of leaves. The purpose and condition of the life of the tree are revealed in no small measure by its leaves.

The needle of the pine enables the tree to withstand a hurricane on a mountain top, yet its slender figure is perfectly adapted to the task of gathering light and air for the tree's life.

Not less plainly does the diversity of character in a leaf reveal the diversity of tree life itself. No two leaves are exactly alike;

no two trees are exactly alike. There are specific as well as generic differences which are strongly marked. One tree leads a rugged, wild, and struggling life; another an easy, luxurious life. The rough and fuzzy leaf of the slippery elm, the silky leaf of the beech, the shiny leaf of the gray birch, these are all widely different; but there are also distinct differences between the leaves of the several kinds of birches, elms, and maples.

Still, there are puzzling similarities, and one is often compelled to study minute details in order to make sure of a particular species. The catalpa leaf is mentioned as that having the simplest form. It is without divisions, and has an entire and unbroken edge. The magnolia leaf, which is oval, might as well have been

Fig. 3.—White Oak.

taken as the type; and there are others equally simple. The most complex form of leaf is exemplified in that of the horse-chestnut.

A very interesting exercise may he had in tracing the differences in the shapes of the leaves of trees of the same family,

as of the oaks, where we have the rounded lobed leaf of the white oak, the pointed lobed red-oak leaf, and the obovate, evergreen leaf of the red oak, with numerous transitional and derivative shapes. In the maples, too, the typical three-lobed, deeply indented leaf branches out into a great diversity of forms, all easily referable, however, to the primitive one, the peculiarities of which are dependent upon the depth, the number, and the minuteness of the notchings. Another series of sports is shown in

Fig. 4.—Red Oak.

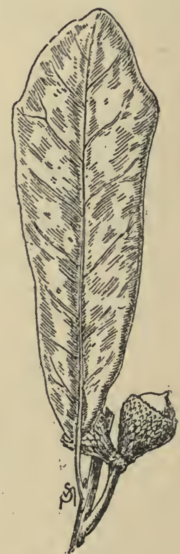

Fig. 5.—Live Oak.

the birch leaves, where the pointed, serrated leaves of the black and yellow birch are quite different in shape and general appearance from the pointed, much-notched, glossy, isosceles-triangled leaves of the white birch. This tree has other marked characteristics. "Notice the bough where it joins the white trunk; this triangular brown patch below the branch is always present in any tree of any age. The leaf stem is slender, rather long, and not downy; the leaf (often growing, as in my sketch, in pairs) is very smooth and shiny on both sides; also, the stem being slender the leaf shakes with the slightest breeze, and its varnished surface, reflecting the sunlight, breaks it into shifting, sparkling green fire."

Another series of sports may be studied in the leaves of the same tree, as the sassafras, of which three plainly marked shapes may be found on the same twig, and the mulberry similarly char-

acterized. A peculiarity of opposite style is presented in the leaf of the tulip tree, which is unique in shape, being cut off at the end and having a marked hollow or notch where nearly every other leaf is angular or convex.

Our space is filled, and we have said nothing of the pinnate leaves, or the spiny leaves, or the leaves of the spruces and firs, of all of which as interesting studies might be made.

Fig. 6.—Red Mulberry.

The greatest sphere of usefulness which a tree occupies, Mr. Mathews says, is connected with its life. It is a great air purifier; it absorbs from the atmosphere the carbonic-acid gas which is poisonous to us; it holds and slowly dispenses moisture which the parched air needs; it gives out the ozone (or oxygen in an active electro-negative condition) which is peculiarly conducive to our health; and it modifies heat which would otherwise be overpowering. Each leaf is a builder up and an air regulator of a nature which is beneficial to us. "Its capacity for heat and sunshine is something astonishing. I have estimated that a certain sugar maple of large proportions, which grows near my cottage, puts forth in one season about four hundred and thirty-two thousand leaves; these leaves combined present a surface to sunlight of about twenty-one thousand six hundred square feet, or an area equal to pretty nearly half an acre. Every inch of this expanse breathes *in* life for the tree, and *out* health for man, while it absorbs in the aggregate an enormous amount of heat and sunlight. In time of rain it also holds the moisture, and allows it to evaporate by slow degrees when hot days return. The forests are vast sponges, which, through the agency of leaves, soak up the beneficent raindrops and compel them

to pass slowly through shaded channels to the parched lands beyond. It is indeed quite impossible to overestimate the value

FIG. 7.—TULIP TREE.

of the billions and billions of leaves which work and build for the benefit of humanity."

M. BERTHELOT reports to the French Academy of Sciences that the subscriptions for the proposed monument to Lavoisier, taken in France and other countries, amount to 47,353 francs, or $9,410. Of this sum, $100 are credited to the United States. The subscription is still open, and considerable sums are expected from particular sources, as the French Department of Public Instruction and the city of Paris; and the Emperor of Russia has headed a subscription list to be opened in his dominions.

THE EDUCATIVE VALUE OF CHILDREN'S QUESTIONING.

By HENRY L. CLAPP.

I KNOW intimately a little boy, now six and a half years old, who has been a persistent questioner since he was four. Thirteen months ago he began to read, and now reads The Youth's Companion, Alice in Wonderland, Lang's and Andersen's Fairy Tales, Kingsley's Water Babies, and Greek Heroes, school readers, and many other books with good understanding and excellent expression. As he has never been to school, and never has received a day's instruction in reading—that is, direct instruction, such as characterizes school work—his progress must be accounted for in some other way. Since it is not my purpose to describe in detail how he learned to read, I will simply say that it may be attributed wholly to persistent questioning on his part, being answered by his hearers, and having ample opportunities to practice what he found out. To this indirect instruction, excessively fragmentary and depending wholly upon his choice, there has been practically no limit.

When he was about four years old he would follow up his questions immediately with "Tell me. Why?" When he was five he introduced every subject he wished to talk about with "What do you think?" At six he dropped that, and substituted "Do you know what?" But, after two years and a half, he seems to entertain no thought of giving up "Tell me."

His favorite times for asking questions are when he is being dressed in the morning and at his meals. At other times during the day his questions occur at very irregular intervals, and only a few or one at a time. Sometimes he will read for an hour without saying a word, and then, when at play, will ask a question pertaining to what he has read. Often he will skip forward and back for fifteen minutes without speaking, and then ask a question about something upon which he has apparently been meditating. Frequently he sits at the table in silence for ten minutes, apparently taking no notice of conversation, meditating on some word or idea obtained from something he has read. It becomes evident, later, that he can carry on his own train of thought and at the same time hear and understand conversation, because he questions about both.

His mother used the word "disposed" at the breakfast table, but he seemed to take no notice of the conversation going on. At night, when jumping about the room for the mere pleasure of movement, he turned suddenly to me and asked, "What does 'disposed' mean?" One morning I heard him ask his mother

"Is there any key of C flat?" Not getting an answer, he continued: "I have asked you a good many times if there is a key of C flat. Tell me." The same morning, at the breakfast table, he suddenly introduced a very inappropriate subject with the question: "Do cannibals ever eat their friends? Tell me." "What made you think of that?" "I have heard people say that cannibals eat other people, and so I asked."

Most frequently his questions refer to some idea obtained from what he has read some time previously. For example: "What does *prudent* mean?" "Where did you see that word?" "In the story about the *Prudent* Farmer in Harper's Third Reader." "What does *verb active* mean?" "Where did you see that?" "In the story about Squeer's school, written by Charles Dickens, you know." "Is a merry heart better than wealth?" "Where did you read that?" "In Harper's Third Reader." "What does *effort* mean?" "Trying to do something. Where did you see that word?" "In the fable of the stork and the fox." "What is wisdom?" "Knowing many things. When a man has many wise thoughts he has wisdom." "Yes," he said, "wiseness." "Where did you see *wisdom?*" "I saw it in the picture of a door. Over the door was a card, and on the card it said, 'Wisdom is strength.' I saw a picture of somebody whispering in an owl's ear, and it said, 'A word to the wise.' Is the owl the wisest bird?" "What is honest milk?" This last question was suggested by his reading a milkman's circular.

On the other hand, many of his questions can not be connected with his reading, but appear to result from reasoning or a recognized analogy. "How do plants make themselves bigger when they grow?" he asked when we were talking about planting his garden. I heard him saying to himself, "Wildless, wildless." I asked him what he was talking about, and he replied: "About plants that are not wild. What are they called?" "Garden or cultivated plants," I answered. "What made you say wildless?" "Why," said he, "I knew that harmless meant something that wouldn't do any harm, and so wildless means plants that are not wild." He mentioned the fall, and I asked him what he meant by fall. He replied: "The winter at first, the first of it. Do they call it fall because everything is falling?" There was some talk about dressing him or putting on his dress, and, reasoning from analogy, he asked, "When God puts the skin on people, is that skinning them?" I once read of the people in the moon being like grasshoppers, and told him about it. When I had finished the story, he said: "When we look up in the sky we see the moon rolling on above us, and when the people in the moon look up in the sky they see the earth rolling along above them. What is the strange puzzle about that?" I told him that his specimen of

mica was silicate of potash, and he asked, "Why is mica silicate of potash? Because they put ashes in a pot?"

These questions have been recorded to represent an innumerable number unrecorded, and to show the wide range of thought and the variety of reasonings that a child under six years of age may have. They show his natural method of acquiring knowledge, but they can only suggest the ceaseless activity of his mind during all his waking hours.

His habit, to a greater or less degree, is the habit of all children. Very early, even before they begin to talk, they manifest a desire to know the causes of things; and they continue to show natural curiosity until they go to school, which they seem to recognize as a place where curiosity is very much out of place, since so little opportunity is given for its exercise. In that case curiosity is apt to be replaced by laziness and apparent dullness.

Out of school they are, with rare exceptions, very thoughtful and exceedingly busy about something. They question much for the satisfaction which they experience in finding reasons or explanations of various acts. Each questions from his own point of view, and thereby increases his understanding and develops his own mind. These voluntary questions engage his whole attention; they are for the time of the highest interest to him, and, on that account, of the greatest importance to his proper mental development. As he leaps about for the mere pleasure of physical movement, his thoughts also dart about among scenes past and present, and imagination carries him on to the future and back again like a flash. What pleasure he takes in these mental and physical movements when he is at full liberty to do as he pleases! He is happy because he is fulfilling the laws of his being, developing his mind and body by his own self-activities. He can not help questioning any more than he can help jumping or thinking.

In a proper home there is only moderate restriction on any of these means of development, and accordingly he develops there very fast. In the fields and woods also there are no restrictions on natural development. Running in the fields, climbing trees, and playing games of all sorts are powerful developing processes. Queries are rapidly formed and as rapidly answered, probabilities are balanced, decisions are made, and bodily movements follow in exact conformity to the judgment and will.

The moment children step into the ordinary schoolroom opportunities for questioning and spontaneous judging and willing are cut off. They are now going to be trained and developed by a logical, systematic, step-by-step method, frequently called normal. All physical movements with any vigor in them must be regulated by a minutely detailed system of gymnastics, which frequently comes to be so dominant that all natural play at recess

must give way to marching and countermarching. In the schoolroom questioning, judging, willing, and spontaneity in general seem to be vested in the teacher alone, to be incompatible with his idea of pupils' right thinking. The educational code there is, "Sit still, ask no questions, learn and recite your lessons, and do what I tell you." This ancient code makes the conditions favorable for the application of questions assumed to be asked after the Socratic method, in which as practiced the pupils' self-activities appear to be very much overlooked.

The universal method of teaching is catechetical, the teacher asking all the questions and the pupils attempting to answer them. The teacher sets the conditions and makes all the attacks on ignorance, negligence, and incompetence, and may be said truly to be on the offensive always; while the pupils constantly attempt to comply with conditions, repel attacks, and conceal their shortcomings, and may be said as truly to be always on the defensive. The mutual relations of teacher and pupils may be quite accurately determined by averaging the conditions which the graduates of various schools remember to have existed when they went to school. How they outwitted the teacher forms a bright spot in the memory. It is long remembered and easily recalled. Like a good joke, it is delightfully piquant and suggestive of similar jokes.

The customary one-sidedness of teaching makes school work more or less disagreeable and progress comparatively slow. It is difficult to excite and sustain interest. Repression, coercion, and machinery become necessary to make the government respected and respectable. Strong disciplinarians rather than good teachers are required when children's activities, either of body or mind, are directed into hard, unnatural channels or are kept down by forcible means. The teacher questions, struggles against the constitution of her pupils' minds, and really dominates them at last. Herbart says, "Tediousness is the greatest sin of instruction." The pupils often feel that their work is uninteresting and difficult without knowing why or how to help themselves; and they learn, often by bitter experience, that it is discreet to obey and learn and recite their lessons, however distasteful they may be. That is the traditional way—the way passed over by their parents, in which they are expected to go, and by which the torrent of their impulsive questions must needs be dammed up for many a long year in the future as it has been for centuries in the past. *Repression* is the word naturally and correctly applied to such a system.

Children's natural, constant, and almost irrepressible desire to question freely about everything that comes within the range of their experience has not been considered of any special value

in educating them. Even Froebel seems to have overlooked its great value as a means of developing reason, judgment, the relation of things, and everything that makes for real knowledge. Out of school it has room. A man may question everything, past, present, and future, but a child's inalienable right to say "Why?" out loud in a schoolroom is hardly recognized. He is to take instruction without question. Traditions in education are almost unchangeable.

Children, as a rule, do not like to be held to a definite line of questioning by a teacher, unless the subject is very interesting by nature. The impressive, commanding, magnetic teacher may have no apparent difficulty in holding the pupils to her questions; but pride in that feat partakes strongly of vainglory. What will they do when left to themselves? What can they do without her? How far can they go alone? To what degree are they self-controlled. Fine instruction has value, but teaching pupils to teach themselves, and simply and skillfully directing their self-activities to that end, is a great deal better. Herbert Spencer says, "Bear constantly in mind the truth that the aim of your discipline should be to produce a *self-governing* being, not to produce a being to be *governed by others*."

President Eliot says: "All teachers who deserve the name now recognize that self-control is the ultimate moral object of training in youth—a self-control independent of temporary artificial restraints, exclusions, or pressures, as also of the physical presence of a dominating person. To cultivate in the young this self-control should be the steady object of parents and teachers all the way from babyhood to full maturity."

There are a few schools in which the pupils feel free to ask questions, when it is necessary, in school time. In many schools there is a standing invitation to ask and answer questions *before and after school.* Such an invitation amounts to a prohibition of questioning. In many schools the pupils are trained to talk; but the substance of the talk is along the old line, reproduction, or a new form of recitation, better than the old, because in the pupils' own language. Nevertheless, training children to question in school time as a means of developing reason, power of comprehension, and self-control is scarcely appreciated anywhere. Even suggestions of children's questioning are exceedingly few in literature on education; but records of its actual practice are unknown. Two lines in Tate's Philosophy of Education and a few lines concerning the Jesuits' methods of teaching in Quick's Educational Reformers are all the suggestions that have come to my notice. The Jesuits divided their boys into two camps and had them question each other, to stimulate rivalry and emulation.

It will be readily conceded that teachers like to question

pupils and to show their skill in questioning. A good many so-called experts consider the ability of the teacher to question logically as the measure of his value. This is a very superficial view of the matter. It has resulted in positive injury to many teachers, and greater injury to more pupils.

Some teachers confess that they are disinclined to allow their pupils to question as a practice, since the questions may be pointless, illogical, and inadequate. That is precisely the kind of work which the school should undertake to remedy. The pupil's questions reveal the condition of his mind quite as much as his answers to the teacher's questions. His anxiety to avoid errors moves him to say what he thinks the teacher desires. When he questions he is thrown off his guard, and his misconceptions, and feebleness or acuteness of mind are revealed inadvertently and the teacher can help just when and where help is needed without undue interference, which is so common in school.

Moreover, these teachers claim that such freedom as this work necessitates might lead to disorder, or what passes for disorder in the opinion of those who judge the order by the degree of stillness and lack of movement prevailing. So they keep the reins taut in their own hands and set up a despotism of varying degrees of severity.

Many an inexperienced teacher, who has learned this method at some training school for teachers, may charge her failure in maintaining order to her persistence in trying to hold a large class of pupils to her questions. Her logical plans and orderly questions are commonly inelastic, unsuitable, monotonous, and sometimes irritating. She bends the wills of her pupils to her own; but there is too much elasticity in their mental habitudes to endure the strain long. In a few days the monotony of a single voice, hardly still during the day, and the vain attempt to "follow my leader" in her set and searching questions result in restlessness, inattention, and disorder. Her pupils can not readily get used to the one-sided game.

The aims which the average teacher finds the most difficult in reaching are, to secure attention, arouse interest, induce spontaneity, elicit independent thought, give enjoyment, and prevent ordinary school work from becoming or appearing a task. This difficulty also may very largely be charged to the traditional mode of questioning. There is seldom any enjoyment in it. Herbert Spencer says: "Experience is daily showing with greater clearness that there is always a method to be found productive of interest—even of delight; and it ever turns out that this is the method proved by all other tests to be the right one."

All teachers unite in extolling spontaneity in the abstract, but almost universally ignore it in their teaching by reason of alleged

difficulties in reducing it to practice. They are always talking about attention, interest, and independent thought, even to their pupils, while they are continually heading off the development of those desirable attributes by restricting their pupils to answering questions referring to tasks which they have set. Certainly their pupils seldom find "delight" in their questions, but, on the contrary, find comfort in evasion, as they very frequently say they understand the subject under question when they do not, in order to get rid of the galling questions which seem especially designed to reveal their deficiencies and bring about their disgrace.

Supervisor Martin, one of the keenest and wisest observers on the Board of Supervisors of Public Schools in Boston, says in his report recently issued: "If there be a general weakness, it lies in the failure to develop in the pupils the ambition and the power of self-help. The skill of the teachers is more fully exhibited in their presentation of subjects than in stimulating pupils to independent effort. Much of the work is simple giving and taking and giving back." Independent effort being generally wanting, spontaneity of necessity must be wanting, because there can be no independent effort where there is no desire or will to make it. In this regard probably the schools of Boston are no more deficient than schools at large.

But, in view of all the talk made at educational conventions during many decades, it is remarkable how little progress in spontaneity has been made in school, even since Froebel's time.

Froebel said: "I must not neutralize and deaden that spontaneity which is the mainspring of all the machinery; I must rather encourage it, while ever opening new fields for its exercise, and giving it new directions. Can I not then even now gradually transform their play into work, but work which shall look like play, work which shall originate in the same or similar impulses, and exercise the same energies as I see employed in their own amusements and occupations?" Pestalozzi also claimed that "spontaneity and self-activity are the necessary conditions under which the mind educates itself, and gains power and independence."

A careful distinction should be made between children's activities and self-activities, the one often being confounded with the other by teachers. Generally their activities in school result from a compelling force of will, of laws, of penalties, all of which are kept well out of sight in some schools, but in the immediate foreground in most schools. This compelling force is often necessary under present conditions, but not so often as practice would make it appear.

Generally teachers' traditions and scholastic training are no safe guides in dealing with self-activities educationally. Self-

activity is spontaneous, the result of an inside motive. How to teach children to desire to undertake and stick to school work, whether the teacher be present or absent, tradition does not state. To be sure, children's questioning in school as a real educative force and a rule of practice is, it may be, startlingly new; but any means, precedented or unprecedented, that will certainly result in spontaneous activity should be earnestly sought for and fairly used.

The idea of educating children through their activities has of late years found expression in giving them something to do with their hands, as seen in the various forms of manual training. The advocates and teachers of this work indulge the thought and give the impression that it brings out children's self-activities remarkably well. Many fondly believe that by means of it the "whole boy" is sent to school. Nevertheless, his self-activities seem to have but little more opportunity for development than before the doing era, advantageous as that really is. Children in all departments of manual training are taught, instructed, crammed, compelled, it may be, as of old, and then they work out the instruction with head and hand, whereas formerly the head only attempted to follow instructions, more often unsuccessfully. Certainly a great advance was made by the introduction of manual training; but spontaneous self-activity is not a leading motive in the work, if any at all. The work is prescribed.

The child's curiosity or investigating spirit does not receive its satisfaction in any form of manual training now in use. Individual experimentation and investigation have small place in it, so that the need of other educational forces is felt. The spirit of inquiry is much less apparent in school than out. Whose fault is it? Surely not the children's. Nature studies are doing the most to foster the spirit of inquiry, manual training hardly anything. Constructiveness is important, but no more important in education than investigation. Investigation and voluntary work are the expressions of self-activities, while prescribed work is the expression of activities governed by a temporary, outside, dominating influence.

In connection with manual training H. Courthope Bowen says in his work on Froebel and Self-activities: "Broadly speaking, Pestalozzi's plan is one of observing and *imitating;* Froebel's, one of observing and *inventing.* To exercise the *creative,* originating powers of the child is Froebel's main object; to teach the child to speak and to do work already prescribed is largely the aim of Pestalozzi. Froebel's plan, therefore, more directly tends to develop independence and originality of character." To carry out Froebel's plan children must have far more true liberty in thought and action in school than they now have. Their spirit and temper must

be reached if they are to be educated properly. Education must become less Pestalozzian and more Froebelian. So it does become when children question.

The idea of educating children through play, where self-activities are at their best, is not new, having been not only clearly set forth in theory but reduced to practice by Froebel. The only application of the play element as a means of development in our systems of education is found in the kindergarten. No one has shown how it can be made useful in schools beyond the kindergarten. To most teachers it seems utterly incompatible with the work of such schools. They are not willing to admit in any degree that "play is the work of the child." If the play element is of so high educational value in the kindergarten, why is it not of much higher value all along up through the elementary school, where the pupils play much more vigorously, intelligently, and skillfully? Even young men and women who give up so much for baseball, polo, tennis, and golf, prove that the play element abides long; and, although it now results in healthful exercise, and a development of body and mind that is too frequently and unwarrantably claimed as the result of school work, it might be turned to the account of school education if half the time and attention given to prescribed studies were given to it.

Full opportunity to ask questions in the schoolroom *in school time gives the play impulse* in children *an excellent outlet.* Their unique expressions and inadequate conceptions result in questions and answers that are not only instructive but decidedly entertaining to all concerned. They are often irresistibly funny without intending to be. On the other hand, there being ample room for the play of thought, the zest of play frequently runs through their exercises. When the teacher sees the need of comment or explanation, the attitude of their minds is exactly appropriate, and their attention spontaneous and perfect; never so willing and complete when the teacher talks, questions, reasons, prescribes, and compels. This judgment is not the result of a single, ephemeral experiment, but of demonstrations repeated through years.

Under the system of spontaneous questions and self-conducted exercises "blue Monday," so called on account of the apparent dullness of pupils on Monday forenoon, disappears with the apparent exhaustion on Friday afternoon. The opportunity to stand up, turn about, and use muscles and wills in a way that does not savor of militarism and gymnastics conduces to great activity and excellent temper. Appropriate conditions determine the spirit of all life and action.

The habit of asking questions puts the questioner in the attitude of an investigator and develops an active habit of mind. Always to be questioned induces waiting passivity, and the dif-

ference is radical and momentous for true education. In questioning lies the germ of original research; all inventions, discoveries, and progress have come out of it. Only the questioner becomes a discoverer. And since it is obvious—often disagreeably so out of school—that the questioning, investigating habit is the child's most marked characteristic, and the most direct manifestation of a constitutional current of mental action that can not be repressed long any way, and seldom without danger, it seems inexcusable that any educational agency worthy of the name should fail to develop so important a habit by every means possible. Its careful cultivation would be sure to result in such a success in original research as schools have never yet won.

Prof. C. S. Minot says, "To train men to originality in every field of production is the proper function of a true university." Prof. N. S. Shaler made essentially the same statement in the Atlantic Monthly. It is not likely that originality will be called out easily in the university when all through the primary, secondary, and collegiate education, fifteen years or more, it has been permitted to lie dormant. Men do not begin to train trees and vines of mature growth. If originality is to be brought to full fruition in life, its obvious beginnings as seen in children's questions and curiosity must be cherished most carefully, not only in the university, but in every school that leads to the university. Originality, like playing the violin, must be encouraged early, if proper development is to be attained.

Children like better to work or play in company with one another than with adults; and when so working or playing they do not lack for questions and answers. At their parties they play various mental games with much zest. There is no satisfactory reason why this play faculty should not be brought into the schoolroom everywhere as it has been in a few places, by means of pupils' questioning guided by the teacher.

Their questioning has been found especially valuable in all review work, in history, geography, language work, civil government, physics, mineralogy, botany, and mental arithmetic. In the last four studies the questions are nearly always new and *impromptu*.

In this work they find the required variety in questions and voices, they measure their strength with one another, their wit and fancy find expression in amusing and unexpected turns, and their diligent attention and mental alertness are constant. The freedom, pleasure, and exhilaration that are essential elements of the work lead pupils to do their best. Their exuberant spirits, energy, individuality, and originality find proper outlets, and, in consequence, their tempers are improved. They have time to frame and answer questions based on their own data, and a place for

"applying theory, or putting acquisitions into practice, and for personally using for productive ends their disciplined powers." So they learn to stand up unembarrassed, to lose self-consciousness, to think on their feet, to set conditions as well as comply with them, to lead thought as well as follow it, and get that real practice in adapting themselves to constantly changing conditions that will serve them so well when school life has ended. All this work tends directly to that most important acquisition, self-control in body and mind.

Perhaps the greatest benefit derived from mutual questioning is of an ethical nature, since it affords the best opportunity in school for the cultivation of the most refined human relations. The pupils become habituated to deference, self-restraint, politeness, kindness, unconsciousness of self, and equality of rights as regards time, attention, instruction, and opportunity to work without interference. Egotism, selfishness, plagiarism, the desire for display, and the struggle for personal rewards have little room for growth on account of persistent practice in ways that make for qualities of an opposite character. The teacher's illustrations from the workings of society and the administration of government find their appropriate places and are immediately put into practice in this genuine, embryo part of the body politic. The pupil's judgment is constantly appealed to. As teachers have said many times, the pupils seem like one great family, each member working for the common good. The educational value of the boy teaching the boy by simple language and blackboard illustrations is recognized. The reflex action of teaching is seen to be as valuable to the boy as to the teacher.

The ethical value of mutual questioning is especially noticeable in the pupil's graduating exercises, which are the legitimate results of their regular work. Each pupil has an opportunity to do according to his ability. There are no picked scholars, no exhaustively trained precocities, no survival of the fittest, no false show, no tragic or comic declamations or mere mouthings of the misty words of statesmen and poets; but each reveals his own thoughts in his own way, pruned and strengthened by his training. The ease, interest, energy, self-reliance, and politeness with which they carry on their impromptu exercises in the presence of five hundred people can not be understood by even distinguished educators, versed in traditional methods only, who may be present.

The doctrine of opportunity has not been preached enough, and the wonderful constitution of the mind and its power to develop itself by its own energies when fully aroused have been so often and so unjustly claimed as the direct results of systematic or dogmatic instruction that the truth, when held up to view, may not be recognized and acknowledged.

A fitting conclusion to this presentation of the educative value of children's questioning may be found in a brief mention of the children's own thoughts concerning the subject.

There having been no conversation or suggestions concerning the matter, the pupils who averaged fifteen years of age were asked to give their ideas of the advantages of questioning each other, and they expressed themselves thus: "We don't waste time, because if our teacher is out of the room we can go on with our recitation. Having to decide on the answers to our questions makes us think. We have to know more about our lessons if we ask questions than if we only answered them. We have more questions than if our teacher made them all. We are all of about the same age, and understand and misunderstand things in about the same way, and can help each other out. Questioning helps us to talk and obliges us to depend on ourselves. When thirty-eight children are making questions, some one of them may think of a question that the teacher may not think of. We look forward to conducting our graduating exercises without help from our teacher, and this work trains us for that."

THE SELF AND ITS DERANGEMENTS.

By Prof. WILLIAM ROMAINE NEWBOLD.

IN this and my succeeding paper I intend to take up a group of phenomena which involve some of the most perplexing of psychological and metaphysical questions. There is no problem that can be of greater interest to us as human beings than that which concerns the nature of my self, my origin, and my destiny. Of my origin and my destiny exact Science is not yet in a position to say much, and of my nature and constitution she knows little more. The greater interest therefore attaches to those cases in which the consciousness of self seems to be disordered, and, although we are far from a complete comprehension of them, we can go far enough to show that they present phenomena which are closely akin to those which we have been examining.

We may set aside at the outset the notion that the real self is an immaterial, invisible, indestructible something called mind or soul in which my mental states inhere. Whether anything of the kind exists or not I do not know; if it does, we know nothing of it, and it is not of the least significance except as a symbol for the indestructibility of the conscious self. The only self in which I have interest is the self that feels, endures, hopes, and the only self I can know is the self that is manifested in consciousness.

Setting aside, then, this notion of the self as mind or soul

apart from consciousness, there remains as the object of inquiry consciousness as we know it. In my first three papers (December, 1895, January and February, 1896) I have given my reasons for thinking that we may conceive of it as a web containing manifold and constantly shifting strands. Sensations of all kinds, some vivid and some obscure, memories, anticipations, emotions, and deliberate volitions succeed one another in bewildering confusion. Yet at any given moment this apparent confusion is in reality a system the form and constitution of which is determined by laws as inflexible as any that rule in the physical world.

What, then, is my self? Is it merely another name for the whole? Or are there parts of this ever-shifting, kaleidoscopic phantasmagoria which are parts of my self in a more special sense than the others?

I think there are. In the first place, and in the broadest sense of the word self, all those sensations which go to make up my consciousness of my body as distinguished from the sensations which I regard as springing from the outer world are peculiarly mine. The appearance of my body from without, the double sensations that arise from contact of part with part, but especially the vague sensations that are always pouring in from every muscle and joint, from the heart, lungs, stomach, and intestines, these all blend into a confused mass which forms the background or stage upon which the more distinct elements that are supplied by the special senses play their parts. Any changes in this mass I feel as changes in my self. Emotions and moods, and the indefinable difference between the feeling of health and the feeling of disease spring from obscure changes in it, but I feel them as changes in my self.

But with reflection comes a tendency to narrow the meaning of the word self. Who has not gazed in the mirror at what others call his self until the sense of opposition between the real self and that at which he was looking became so intense that he turned away almost frightened and glad to sink again into the old familiar sense of unity with his body? The more I reflect the less does my body seem important to *me*. *I* am the inner life of thought. Most of my thoughts I acknowledge as truly mine, and most of the deeds that spring out of them I recognize as belonging to me. But occasionally a thought appears toward which a sense of strangeness arises—it seems none of mine. Possibly because it is so much better than my usual thoughts that it seems like a breath from a higher world, possibly because it is so wicked that I am almost tempted to believe it comes from a devil, possibly merely because it is insistent and does not go when I bid it. So of the impulses and desires that control me. Most of them are mine, but now and then I do something toward which I feel, when

I look back upon it, a curious sense of irresponsibility, as if it were not of my doing after all. Such deeds are always those which I seldom do; my everyday virtues and my everyday vices I must admit are mine.

But there is just one thing which I always acknowledge as mine. It is the sense of effort. It matters not whether I employ it in contracting my muscles to the utmost, in fixing attention upon some uninteresting object, in following some distant end in spite of the solicitations of the present, or in overcoming for some moral reason the claims of the greater pleasure—this sense of effort I always acknowledge and always must acknowledge as mine.

The word self, then, seems to stand for the most frequently recurrent elements of my inner life, with the consciousness of effort as its very essence and core. But it is evident that we can not, whenever we speak of it, think all these things. To evade that necessity most men probably make use of some vague thought symbol which the word self suggests. Symbols of this sort are known as concepts. They play a great part in our mental life; without them the marvelous achievements of the human mind would never have been. Yet they are so shadowy and evanescent that it is almost impossible to determine their precise constitution, and the more complex and diverse the phenomena they stand for, the greater the difficulty of fixing and describing them. The task is almost as fruitless from the practical point of view as it is vain from the speculative, yet an immense amount of labor and ingenuity has been expended upon it. Most of the work commonly termed metaphysical is based upon the conviction that these shadows are or represent realities apart from the concrete things for which they stand; sundry attributes are ascribed to them, and out of these imaginary attributes the metaphysician tries to construct a science. Most of the difficulties that attach to the notion of a self or ego spring out of this confusion between the symbol and the things symbolized, and I shall therefore say no more of the symbol, but confine myself to the concrete states of consciousness which constitute my thinking self and which alone possess interest for me.

If this analysis of the self be true, it will follow that the consciousness of self can be modified by the addition to or subtraction from my inner life of large masses of stable elements, and this appears to be borne out by the facts.

Extensive changes in the mass of bodily sensation are frequently accompanied by modifications in the sense of self. I can not go into this in detail, but those who care to follow the subject out will find it treated at length by Prof. Ribot in his little monograph, The Diseases of Personality.

Great changes in one's circumstances and surroundings are often connected with similar changes in the self-consciousness. A journey to a foreign land, the sudden death of a relative or friend, a great disappointment in love or in business, or an equally great and unexpected success—all these necessarily involve the demolition of many of one's most permanent habits, plans, and expectations. There may follow a period of confusion in which the self of the present moment looks back upon the self of the past as a very different being.

Analogous changes take place normally in the course of life with the constant addition of new experiences and development of new instincts. The sense of self usually changes imperceptibly to keep pace with these new growths, but sometimes the change can be felt. The young man or young girl sometimes notices it during or at the close of the period of adolescence, and we frequently become conscious of it at other times, when something brings very clearly to mind the events of years ago. Not long since I ran across a book over which I used to pore as a child, but had not seen for years; when I opened it, my present self for just one moment fell away, and I was again a child of eight. It was a strange experience, and the childish self that then for a second or two lived again was much more unlike the present *I* than I commonly think of it as being.

If our memories are constituent parts of our self-consciousness, it follows that any extensive abolition of memories will impair or destroy a man's sense of self. This is so common a phenomenon that I need not quote illustrations. More interesting are those cases in which certain portions of a person's memory are abolished and restored at varying intervals, especially when illusory memories and other delusions are commingled with the memories that remain. In such cases we get true modifications of the patient's personality. One of the best known of these cases is that of Ansel Bourne.*

Mr. Bourne lived in a village near Providence, R. I. On January 17, 1887, he went to Providence, drew five hundred and fifty-one dollars with which to pay for a farm he intended to buy, and then disappeared. About two weeks later he appeared in Norristown, Pa., styling himself A. J. Brown, rented a room, divided it in two by curtains, lived and slept in the rear room, and opened a little shop in the front for the sale of toys, confectionery, notions, etc. During the six weeks he lived there no one noted anything unusual in his demeanor.

"On the morning of Monday, March 14th, about five o'clock, he

* This account is abridged from Dr. Richard Hodgson's paper, A Case of Double Personality, in The Proceedings of the Society for Psychical Research, vol. vii, pp. 221–257.

heard, he says, an explosion like the report of a gun or a pistol, and, waking, he noticed that there was a ridge in his bed not like the bed he had been accustomed to sleep in. He noticed the electric light opposite his windows. He rose and pulled away the curtains and looked out on the street. He felt very weak, and thought he had been drugged. His next sensation was that of fear, knowing that he was in a place where he had no business to be. He feared arrest as a burglar, or possibly injury. He says this is the only time in his life he ever feared a policeman.

"The last thing he could remember before waking was seeing the Adams express wagons at the corner of Dorrance and Broad Streets, in Providence, on his way from the store of his nephew in Broad Street to his sister's residence in Westminster Street, on January 17th. He waited to hear some one move, and for two hours he suffered great mental distress. Finally, he tried the door, and, finding it fastened on the inside, opened it. Hearing some one moving in another room, he rapped at the door." His landlord opened it, and from him he learned where he was, how he came there, and what day of the month it was. The landlord thought he was insane and sent for a doctor, and the doctor telegraphed for his relatives and had him taken home.

Prof. James, of Harvard, and Dr. Hodgson heard of this case about three years later, and got Mr. Bourne's consent to their investigating it. Prof. James hypnotized Mr. Bourne, with the hope of reviving the Brown state, and was surprisingly successful. He told the story of his wanderings correctly, giving clews to his doings during the two weeks that elapsed after he left Providence and before he appeared in Norristown. Of his own history he could tell very little. Said he: "Seems as if I was sot right down there in Dorrance Street without knowing where I came from. Got into a spot, don't know how I came there, both ends are blank." His name, he said, was Albert John Brown. He was "born in Newton, N. H., July 8, 1826 [he was born in New York city, July 8, 1826], had passed through a great deal of trouble, losses of friends and property; loss of his wife was one trouble—she died in 1881; three children living, but everything was confused prior to his finding himself in the horse car on the way to Pawtucket; he wanted to get away somewhere—he didn't know where—and have rest. . . . He had heard of the singular experience of Ansel Bourne, but did not know whether he had ever met Ansel Bourne or not. He had been a professor of religion himself for many years, belonged to the 'Christian' denomination, but back there everything was mixed up. He used to keep a store in Newton, N. H., and was engaged in lumber and trading business; had never previously dealt in the business which he took up in Norristown. He kept the Norristown store for six or

eight weeks—how he got away from there was all confused; since then it had been a blank. The last thing he remembered about the store was going to bed on Sunday night, March 13, 1887."

Some of these statements are true and others are not. He was never in Newton, N. H., in his life, and never engaged in any kind of trade. He had been a carpenter, farmer, and itinerant evangelist. His first wife did die in 1881, but he had married again; of his second wife the Brown personality never had any knowledge.

The nature of this change of personality is now fairly clear. The greater part of Ansel Bourne's memories were obliterated; the few that remained had lost all organic connection with one another, and gave rise to illusions of memory. Probably his new name and his notion that he had engaged in the lumber and trading business sprang from confused recollections of his own name and of his trade as a carpenter. But there was no material change in the active side of his nature. His character and instincts remained pretty much what they had been before. Further inquiry showed that he had had several epileptiform "fainting fits" within the last few years, and had been early in life the subject of a sudden loss of sight, hearing, and speech, followed by a "miraculous" cure.

Another typical case is that of Félida X——. This girl was first seen by Dr. Azam, of Bordeaux, in June of 1858. She was then about fifteen years old. About two years before hysterical symptoms had appeared; between her fourteenth and fifteenth years, at intervals of four or five days, and especially after some emotional excitement, she would feel a pain in the temples, followed by overpowering drowsiness. After an apparent sleep of ten minutes or so she would awake in a secondary state. It would last an hour or two, and then she would pass into her ordinary condition through a period of unconsciousness, as before.

In the primary state she was perfectly sane, was intelligent, resolute, and diligent, but taciturn, gloomy, even morose. She was not affectionate, was inclined to dwell upon her condition, and suffered much from pains of obscure origin. In the second state she was gay, hummed a tune over her sewing, was quick of movement, vivacious, fond of visiting, was emotionally sensitive and generally flighty. Her pains were much better. In her first state she remembered all her childhood and what had happened during other occurrences of the same state, but nothing of the second. In the second, however, her memory was complete, embracing the first as well as the second. She then spoke of her primary condition as her "attacks" (*crises*) or as that "stupid state" (*cet état bête*). Occasionally a third state made its appearance. The transition was as above described, but in it she seemed

mentally confused, was the prey to intense terror, saw horrible visions, etc.

She married when between sixteen and seventeen years of age, and Dr. Azam lost sight of her for sixteen years. In 1876 he hunted her up again, and had kept her in sight until the appearance of his book in 1887. Considerable changes have taken place in her condition. The transition states are much shorter, being scarcely noticeable. Her second state has continuously gained ground upon her first, so that in 1865, ten years after its first appearance, her life was about equally divided between them. In 1875 the first only recurred at long and irregular intervals and lasted only a few hours. In 1887 its recurrences were rarer and shorter still. Throughout her life she has been a hysteric of the worst kind. She had had her sensations of touch, taste, and smell impaired, she had had frequent hæmorrhages from the nose, lungs, and stomach, and when excited had convulsive attacks. On one occasion she had a hæmorrhage from the scalp. Red spots often appear on the left side of the body and are accompanied by pain and heat, frequently by swelling. One such swelling on her hand burst her glove. The third state, that of panic terror and mental confusion, has become much more frequent and lasts longer. With advancing years and troubles her second state has become less gay and careless, so that the contrast of character is not so marked, but the gulf in her memories remains as wide as ever. She went to a friend's funeral in the second state; on her way home she passed into the first and could not imagine what brought her into a carriage full of mourners. Her sister-in-law died after a long illness; Félida passed into her first state and knew nothing of her death, but, remembering her illness, inferred that she had died from the mourning garb in which she found herself clad. Once in her second state she grew jealous of another woman and tried to hang herself, but was cut down in time by her neighbors. When she recovered she expressed the wish to go into her first state, for then, she said, she would forget her misery. And she did, for the next time she passed into it she showed herself most affectionate to the former object of her jealousy.

The changes that take place in Félida's case are more far-reaching than those of Ansel Bourne. Not only are large blocks of memories erased, but the active side of her mind is profoundly affected. Yet one would scarcely say that the two Félidas were different people. Rather does it seem that the real Félida is the second, the one which first came to light amid the changes of adolescence. It is like Ansel Bourne's case reversed, for A. J. Brown is Ansel Bourne shorn of nearly all that was his; the second Félida is the first Félida completed by the addition of much that was her birthright.

I have already alluded to the fact that Ansel Bourne early in life suffered a sudden loss of sight, hearing, and speech, and as suddenly regained them; and in the case of Félida I also alluded to her hysterical condition and to her third state. Now, all these phenomena from the purely psychological point of view belong under the same category. The sudden splitting off from the true Ansel Bourne of a mass of states and tendencies which took a new name and called themselves a new person is precisely analogous to the equally sudden splitting off from Ansel Bourne's consciousness of his powers of sight, hearing, and speech. In my first three papers I have developed at length the conception of consciousness as a co-ordinated system capable of greater or less dissolution or disordination without the destruction of its component elements. These two cases are illustrations in point. In both the period of complete disordination or "unconsciousness" was very brief and was followed by a recombination of the elements which had formerly constituted a personality into a distinctly new system, which in one case assumed a new name. In Félida's third state we have a third recombination of some of these elements, but it is apparently very imperfect, for it is accompanied by hallucinations, and hallucinations depend in large measure upon defective coordination. In the case of A. J. Brown the new system seemed relatively quite stable, for it was evoked three years afterward by simply disordinating Mr. Bourne's consciousness. Yet in its later occurrences it appeared to be disintegrating.

I have spent a good deal of time upon these three cases because their relative simplicity, their similarity, and the care with which they have been observed make it easy to form a conception of the way in which the successive states were related to one another. The next which I shall take up does not differ from these in kind, but is much more complex. In it we see the patient's memory-store split into at least five groups, among which the use of his sense organs and muscles is repartitioned in a most curious manner, while his character presents in each state certain distinctive traits.

Louis V—— was born in Paris, February 12, 1863, of a dissolute and hysterical mother and an unknown father. Even in his early childhood he was hysterical, had hæmorrhages from the stomach and transient paralyses. His mother maltreated him, and he became a vagabond. At eight years and a half he was committed to the house of correction at Saint-Urbain. His health was fairly good until March 23, 1877, when he was frightened by a viper, which wound itself around his arm while he was gathering wood. That night he had a violent attack of convulsions; when they passed away, his lower limbs seemed permanently paralyzed. His character was gentle and timid. Three years later he was

transferred to an asylum at Bonneval, where he was taught the trade of a tailor. After two months he had a convulsive attack which lasted fifty hours; at its close the paralysis had disappeared and with it all recollection of the past three years, including all that he had learned in the tailor shop. His character and tastes had also changed. He had become quarrelsome, greedy, and rude. Formerly he did not like wine, and used to give his allowance to his comrades; now he stole theirs whenever he could. He robbed a fellow-patient and escaped; when recaptured he fought savagely with his captors. In June, 1881, he was released as cured. For the next three years and a half he spent the greater portion of his time in insane asylums in various parts of France. In January of 1885 he escaped from the Bicêtre in Paris, where he was then confined, made his way to Rochefort, and enlisted in the marines. He was soon arrested and convicted of theft, but was thought to be insane and was sent to the asylum. There he fell into the hands of Professors Bourru and Burot, of the medical school at Rochefort. With infinite pains they recorded his condition, traced out his past history, and in their little book, Variations de la Personnalité (Paris, 1888), have given us a very careful analysis of the phenomena which he presented. After his release from Rochefort, Louis V—— was studied by other alienists, especially by Dr. Mabille, of La Rochelle, and Prof. M. J. Voisin, of the Salpêtrière. Of late years his health has improved and many of his strange symptoms have disappeared.

The case is too complex to be given at length; a brief outline must suffice. MM. Bourru and Burot found that his conscious existence seemed split into at least five major states, in some of which several minor ones might be distinguished. In each state he remembered certain portions of his life, possessed certain sensations, had control of certain groups of muscles, and manifested certain traits of character. Each state could be induced in two ways: (1) By applying an electric current, magnet, or some substance—such as a bar of soft iron or a piece of gold—to a definite portion of his body; (2) by suggestion. Later Dr. Mabille discovered a third method of induction: by pressing upon certain groups of muscles he could cause them to become rigid, and then the patient passed into that state in which those muscles were regularly rigid.

Of these five states, the most important—that is, the one in which he approached most nearly to the normal—could be produced by applying a bar of soft iron to the right thigh. In it he was free from paralysis, and the strength of his arms was nearly equal, but his left side was abnormally sensitive. His character was that of an agreeable but commonplace young man; his language was correct; he could read and write fairly well. He re-

membered the greater part of his life, but forgot the periods during which he had been in other states.

Of the four other states of which I shall speak, the first three are marked by paralysis, sometimes accompanied by contracture, of the left side, right side, and lower half of the body, respectively; in the fourth he is free from all paralysis. With the paralysis the sensations of the paralyzed portions, including those of the special senses, are diminished or abolished.

When paralyzed on the right side he is excitable, violent, and impertinent; smokes all the time, and bothers every one with demands for money or tobacco. His speech is thick and almost unintelligible. He fawns upon those who are kind to him, but if crossed in the least flies into a rage. He professes himself an atheist and ultra-radical, and desires to kill those who exact of him tokens of respect. He either boasts of his thefts and justifies them or denies them altogether. He remembers very little of his past life, but, so far as it goes, his memory is excellent. He lives chiefly on milk.

Applying a magnet to the right arm causes difficulty in breathing, anxiety, mental confusion, slight movements on the right side; then the paralysis, anæsthesia, etc., all pass to the left side. His character is absolutely reversed. His speech is correct; he is gentle and polite; he thinks himself too ignorant to have opinions on questions of politics or religion. He no longer drinks milk at all. Of his former life he remembers only those fragments in which he was paralyzed in the same way.

Upon applying a magnet to the nape of the neck, the paralysis and anæsthesia pass to the lower half of the body. He is depressed; his speech is childish; he can barely spell the simplest syllables. He is stupid, and can not give his age correctly, but he can sew quite well. His memory covers those three years only during which his legs were paralyzed and in which he was taught the trade of a tailor.

Upon passing an electric current through his body, or applying a magnet to the top of his head, a fifth state is produced. He is free from all paralysis, and finds himself transported to the day when he was frightened by the viper. His muscular strength is about two thirds what it was in his first state; his character is that of an amiable little boy of fourteen. While in this state he fell asleep and dreamed aloud of his days at the reform school, telling a lazy companion that he ought to be grateful to the kind superintendent, and try his best to escape the vagabond's life which was otherwise in store for him. For his own part, he said, he was grateful to the judge who sent him there; he was sick and ignorant then and would have been lost, but now he proposes to lead an honest life of labor. The doctors tried to keep him in

this state and bring him gently to a consciousness of his true situation, but he soon fell into a convulsive attack and passed out of it.

I have no comments to make upon the reported efficacy of magnets and other physical agents in producing these phenomena. Most neurologists maintain, I believe, that they act only through suggestion, but a few claim that they have in some cases a specific effect. I have never seen any such phenomena myself, but the evidence is strong and the field seems to me one of the most promising for psycho-physiological investigation.

Quite apart from that, there can be no doubt that this constant shifting and redistribution of the elements of Louis V——'s personality rest at bottom upon a physiological foundation. Especially significant is the impairment of speech, when the paralysis was transferred from the left to the right side. The right side of the body is controlled by the left hemisphere of the brain, and *vice versa.* Now, it is known that in right-handed people the organ of speech is situated upon the left side of the brain. If these phenomena were wholly dependent upon suggestion, the patient's mental symptoms would correspond to what he thought they ought to be. But he would scarcely know that a right-sided paralysis ought to be accompanied by disorders of speech. It seems to me quite certain that in one of these states the right hemisphere was chiefly active and in the other the left; it is fair to infer that his other states depended also upon the functioning of definite portions of his brain, although one can not specify what those portions were.

Mr. F. W. H. Myers, in commenting upon this case,* conjectures that possibly in all of us the right hemisphere is less highly evolved than the left, and that, "just as certain of our visceral arrangements retain the traces of our prehuman ancestry, and just as our dextro-cerebral speech centers are often stammering, childish, or wholly inefficient, so also our dextro-cerebral 'character-forming' centers—the centers which on that side of the brain sum up or represent our highest activities—may retain, in their inferior evolution, traces of that savage ancestry which forms the somber background of the refinements and felicities of civilized men."

Louis V——'s states, although more complex than those of Félida X—— and Ansel Bourne, do not differ from them in kind. In all we have an apparent dissolution of the conscious self and the reconstruction of its elements into a new form. But one of these forms calls for special comment. In his last state Louis seemed to have fallen back into the condition in which he was

* Proceedings of the Society for Psychical Research, vol. iv, p. 23.

eight years before. This is more than a reconstruction of elements; it involves the revival of much that we usually suppose to be irretrievably lost. If such a recrudescence of the old childish self is possible, we must suppose that the growth of the brain is carried on like that of an onion, layer upon layer. Of course, I do not mean this literally. I merely mean that those portions of the brain which were active in childhood, the activity of which constituted my self of that period, may exist years after they have been disused, and then suddenly be brought into action again. Many such cases have been reported. The patient is described as literally relapsing into childhood; her thoughts, memories, desires, acts, even her writing, are those of her former childish self. It is claimed by others that there is no true relapse into childhood; the patient merely acts the part of a child according to her present notion of what she used to be. I have no doubt myself that it is possible. If A. J. Brown could lie dormant for three years under Mr. Bourne's skull only to revive the moment Mr. Bourne was hypnotized, I see no reason why our childish selves may not also survive, and in some cases there is good reason to think they have done so. But most of the cases reported are susceptible to the other interpretation, and, as it is the most simple and natural, I would resort to it whenever possible.

In my next paper I shall take up those derangements of personality in which there seems reason to believe that the secondary system does not wholly perish upon the reconstruction of the first.

EXAGGERATION AS AN ÆSTHETIC FACTOR.

By M. F. REGNAULT.

EXAGGERATION is a natural tendency of our minds, and the fact is recognized by every psychologist. Yet, when we study human thought and action, we forget the propensity to exaggeration and exercise our ingenuity in accounting for seemingly odd social facts which could be readily explained by applying this principle. There are not, perhaps, any branches of human activity in which the tendency to exaggerate is not marked. We might observe its effects in all branches of science if we should bring them up one by one. In history, persecutions and revolutionary disturbances have resulted from the exaggeration of an idea which may have been just in itself, but, taking possession of the mind, it assumes an absolute character, while nothing intervenes to counterbalance it; and, acting under the domination of an exclusive preoccupation, men commit deeds of a most astonishing character. In linguistics, the influence of the same prin-

ciple may be seen in the transformation of languages, through the prevalence in certain classes of society of the affectation of peculiar pronunciations. So the investigator, having discovered and proved a fact, tries to generalize it and magnify its importance; and sometimes he is able to make his contemporaries participate in the error. Yet the exaggeration is occasionally justified, and then occurs one of those great discoveries that mark new eras.

I shall not go into all these questions, but shall examine simply the part played by exaggeration in our idea of the beautiful; nor shall I consider whether, as some philosophers believe, there is an ideal of beauty—a beau ideal—outside of and above us, but shall confine myself to the illustration of the conceptions of beauty exhibited in the customs of the various races of men.

When we look at the ornamentation of costumes, for instance, and at devices for enhancing personal appearance, we find that they have been carried so far as to provoke mutilations. The negroes of Africa, strongly differentiated as they are from other races, are prone to exaggerate the peculiarities of their physiognomy. With lips already thick, some tribes stick thorns into them to provoke irritation and cause them to swell out still farther. The Wolowe women of the Senegal have learned to increase the prognathism or projection forward of the upper jaw. According to Faidherbe's description of the process, "as soon as the girl child's first incisors have appeared, they are extracted with a pair of pincers, and when the second begin to come out they are forced by a continual action of the lower incisors and the tongue into a forward direction." The negro women of the shores of Lake Tanganyika, to make their breasts larger, cause them to be stung by ants. The women of the Assinians of Guinea are, according to Mondière, still more ingenious. It is a sign of beauty among them, he says, to have the largest possible nipples; and "children of five years, as well as larger ones, may be seen hunting the nymphæ of the *Myrmidus fornarius* and pulling at their breasts while the insects bite them, to make them swell more quickly."

The negroes are also proud of their woolly hair, and some of them go so far as to build an enormous structure on their heads. Travelers say that the plaited headdress of the young women at Jenna, in the valley of the Niger, looks like a dragon's crest. The same custom prevails in Oceania among the Fijians, who have woolly hair too, and wear coiffures measuring as much as about five feet in circumference.

Many peoples—Malays, Kirghis, Hottentots, Namaquas, Bushmen, Brazilian Indians, and Society Islanders—are addicted to the practice of flattening their noses, and sometimes, as in the case of

the Hottentot Venus, they break the bone. On the other hand, peoples who have thin noses can never get them aquiline enough. Persians cultivate this shape by pressing the sides of the nose, and the custom existed in France in the sixteenth century.

Paint, by which the appearance of the features may be modified at the least cost, is much used by all peoples. Sometimes it is employed to extend the beard. Aino women think it a fine thing to have a mustache, and by this means give themselves a full one. Opposed to them are the American Indians, who, being almost beardless, pull out the few beard hairs they have.

Black eyes and thick eyebrows are highly esteemed in the East, and the women use kohl for the production of the desired effect. The ancient Egyptians were fond of large, almond-shaped eyes, and produced the appearance of them by painting a prolongation of the outer commissure of the eye. The custom prevailed widely, and is represented in all the sculptures. The Japanese, too, like almond eyes, but want them oblique, and secure that appearance in the same way, only giving a different direction to the stroke. This particular custom has disappeared from among other peoples, but the use of paints still continues, and we paint our lips rosy and blacken our eyebrows.

The origin of these practices is evident. There are others the motives of which are more debatable, but are elucidated on comparison with these. We mention especially the atrophy of the feet among the Chinese. Some have attributed it to the jealousy of husbands, or to regard for a queen who lived many centuries ago and was lame; but Malte-Brun and Ploss say that the Chinese naturally have small feet. Their women have sought to exaggerate this ethnic characteristic.

The object, in the examples we have cited, has been to accentuate a characteristic of the race. In other cases man exaggerates the weight or the volume of an ornament assumed originally for another purpose. According to Herbert Spencer, the ornament was primarily a sign of distinction. It was worn in a conspicuous place as a testimonial of a successful hunt or of a victory over the enemy. Savages still hang human teeth or the claws of wild beasts from their noses, lips, and ears. The Chibchas wear in this way chains formed of as many golden feathers as they have slain enemies.

The next step is to increase the volume and weight of the ornaments. Under the spur of emulation the ear lobe, for example, is loaded down with trinkets till it is stretched so as to touch the shoulder. The enlargement of the ear lobe then becomes the desirable thing to the savage, and his chief effort is to bring it about. Under a like perversion of taste, similar effects are produced with the stick inserted into the thick of the lips. In this

way some peculiar features of mutilation hitherto obscure to ethnologists are reasonably explained—deformations practiced in all the quarters of the world by diverse peoples in no way related to one another, but urged by the same thought arising spontaneously in their minds. The value of the object inserted in the ear, lips, or nose varies according to the wealth of the wearer. The rich use something that is considered precious, as alabaster, rock crystal, or ivory among different African tribes; while a poor man contents himself with a disk of horn or metal, or even a simple rolled leaf. The more wealthy he is, the heavier is the ornament and the more accentuated the deformation. While attention has not been particularly directed to this point, some travelers have noticed that the degree of mutilation varies in the same people according to the coquetry, wealth, or rank of the person. Sometimes the fancy runs to enormous bracelets and rings, the Bongo women wearing such ornaments weighing twenty-five kilogrammes. These shackles of enormous weight have been interpreted by some sociologists as reminiscences of slavery; Park Harrison supposed that the enlargement of the ear lobe was an offspring of sun worship; and other authors have invented a desire to resemble venerated animals as the prompting motive for mutilations.

Of kindred character with the deformations already described are those due to a desire to show that the subject is not obliged to work for his living. The mandarins and *literati* in Annam and China let their finger nails grow long and inclose them in sheaths. A similar custom exists in Polynesia and some parts of Africa. Fatness is a mark of woman's beauty and signifies ease and wealth in Uganda and among the Tuaregs. In contrast to these, the Javanese are proud of extreme thinness, and eat clay to produce it. This is an exaggeration of a characteristic of their race, for they are naturally slender.

Whatever is the fashion comes from the principle of exaggeration, and our clothes are shaped according to the same law. It is not more ridiculous to stretch the ear lobe till it lies on the shoulders than, as was done at the end of the fourteenth century, to wear shoes with toes so long that the ends of them were tied to the knee; or to wear the enormous ruffs of the reign of Henry III of France, and those structures which nearly doubled the height; or the headdresses of the time of Louis XIV, or the extravagant crinolines of thirty years ago.

We look upon the ways of our ancestors as ridiculous and incomprehensible, without considering that we are acting very much like them. We often meet at parties and balls persons who go beyond the present fashion, some exposing more of the shoulders, and some wearing more pointed shoes. A fashion modest in

the beginning is made absurd by a continued course of exaggeration. We never reach the most extravagant form in the beginning, but it is the culmination of a series of modifications becoming progressively more accentuated. Thus, the long-toed shoes were the growth of more than a century. The point began about the middle of the thirteenth century, reached its longest at the end of the fourteenth century, and disappeared all at once in 1420, when it gave way to the square-toed shoe.

The influence of exaggeration in forming the ideal of beauty is illustrated, too, in the art of different peoples. One of the elements of a Siamese woman's beauty is, according to M. Léon Rosny, an arched shape of the eyebrows, causing them to resemble crescents; and if we examine photographs of these women we shall find that the curvature of the eyebrows is indeed more marked in them than in their neighbors, the Annamites and Burmese. This feature is much exaggerated in their statues, and is most strongly indicated in the Buddhas in the *Musée Guimets.* The Hindus are even more slender and tall than Europeans, and admire a full pelvic development in women. While we have tightened our corsets to increase the appearance of slenderness and heighten the contrast between the waist and the hips, our admiration for classic art has prevented our carrying these exaggerations into statuary; but the Hindus have not refrained, and their works therefore have a very peculiar character.

The Siamese and Hindus, however, are not highly esteemed as artists. We will now, therefore, take some examples from a people in whom the high excellence of this faculty is undisputed—the Japanese. While their designs are usually very various, when they come to depict feminine beauty they exhibit a single type, which we find identical on all the "Kakemono." It is a strange kind of beauty, with the face greatly elongated, the nose continuing the profile of the forehead, and the eyes excessively oblique; a beauty rare enough in Japan, where the plebeian woman's face is short and round, but which may be found in the patricians and in the courtesans of high rank. We can prove the exaggeration here by figures. In the Japanese photographs the line of the eyes forms an angle of from two to seven degrees with the horizontal. This is said by some authors to be only in appearance, but M. Regalia has proved its reality by measurements of the cranial orbits. In the Japanese drawings the line makes an angle of from thirty-five to forty-four degrees. A comparison of these with old drawings of the eighteenth century will show that the exaggeration has become much more marked in the present century.

The Grecian portrait seems the perfection of the human type to us, and artists copy it, although it is actually rare. In it the

line of the nose is more or less perfectly the prolongation of the line of the forehead. The hollow at the root of the nose is almost effaced, and the prominence of the nose is softened. The absolute Grecian profile would therefore be represented in a drawing by a single continuous line for the forehead and nose. Yet another condition is essential for obtaining the fine Grecian profile. The forehead should not be receding. This marks the distinction between the Grecian and the Egyptian profile. The artists who lived under the Theban dynasties represented the human profile by a single line for the forehead and nose; but the line was oblique, making the nose prominent and the forehead retreating. They simply exaggerated a race characteristic—as may be shown by examining the mummies or the fellahs of the present time.

Several theories have been offered to account for the Grecian type of profile. Its existence in the Hellenic race has been denied. The few Grecian skulls in our possession present it very rarely, but some of them incontestably approach it. It may have been more common in the aristocratic caste. We must certainly acknowledge that it was not common, but it does not follow that it did not exist. It may still be found, though not very often, at Arles and Marseilles; and I have perceived it in some profile photographs of Greeks of Asia Minor in the collection of the *Société de Géographie* of Paris. It has been suggested that the Grecian profile was hieratic, borrowed from the Egyptians, improved upon and transformed. It is true that the archaic Grecian sculptures, as at Mycenæ, display a profile with salient nose and retreating forehead, and that the type was persistent on many funeral vases. Grecian art may have imitated Egyptian in its beginnings, although it is believed now that the imitation did not play a very preponderant part in the matter. But when, at a later period, the artists created the special profile of their statues, they could not have been guided by reasoning alone. This would be opposed to all the observations on the subject made by other people. They may have designed it, but to do so they had to start from visual perceptions. A third supposition is that the artists exaggerated a type which they had opportunities of observing among their countrymen, especially in the aristocratic and literary classes. An examination of the ancient statues will throw light on this point. In studying the pictures of the great men of Greece reproduced in the *Iconographie Grecque* of Visconti, it will be remarked that a large number of them resemble the ideal type copied in the statues of the gods. In order to proceed with mathematical exactness we have measured the angle, the apex of which is the root of the nose and the sides a line drawn from that point tangent to the forehead (disregarding the projection of the sinus) and the prolongation of the line of the nose. We have ap-

plied this measurement to twenty-seven profiles of statues of celebrated men, passing by all that could not be certainly identified, and taking only those on which the name was engraved, and which bore evident resemblance to the figures on their medals. We likewise passed over mythological personages like Homer, Sappho, and others, whose existence is not fully proved, and kings whose features might have been idealized for the sake of flattery. The angle thus determined measures from seven to fifteen degrees on the master-works of ancient statuary, statues of divinities and heroes. Of the twenty-seven human statues measured, five had angles of fifteen degrees or less, seven of between fifteen and twenty degrees, eight of between twenty and thirty degrees, and seven of thirty degrees and more. A small number of these profiles, it will be observed, present angles not departing greatly from those of the statues of the gods. We do not establish a mean from these, for we recognize that the sculptor may have exaggerated in the case of subjects who presented marked profiles. It can not be objected that the artist sought to idealize these men of genius; for the purest profiles are not those of the most celebrated characters. Solon, Plato, and Socrates, who enjoyed so great fame, appear to less advantage than Hermarchus, Bias, and Epaphroditas, who were much less well known.

We can obtain a more exact conception of the special characteristic of these statues by comparing them with the figures in Visconti's *Iconographie Romaine*. The Romans all had a very convex nose with the root usually depressed; and a tangent could not be drawn from that point to the forehead, even if the projection of the sinus were neglected. Of fourteen persons examined, only four had that line tangent to the forehead, while it was secant on all the others. The Grecian bust, on the other hand, had it tangent, with only two exceptions. Furthermore, the angle is very open in the Roman busts, ranging from twenty-four to forty-eight degrees. It appears, then, that the Greeks, like other peoples, established their ideal type by starting with the real and exaggerating certain qualities.

In this study of exaggeration as an element of æsthetic art, I make no criticism, but rather place myself in the position of those artists who see in the ideal something beyond and above the real. This conception has been assailed. In the eyes of many, the artist should confine himself strictly to copying the real, and be nothing but the inferior rival of the photograph—or rather, perhaps, of the composite photograph, which gives the mean of the features of several persons by fixing them upon a single sensitive plate. When anthropologists recognize the merits of artists' canons, they regard them as the expression of the truth, because they represent the mean proportions of a large number of in-

dividuals. The camera is doubtless useful to beginners, and helps them to avoid great errors; but the artist has nothing to do with it; he takes his inspiration from Nature, and his canon will vary according to the subject he treats. A slender and nimble runner will not have the proportions of an athlete. Furthermore, the artist will put something of his own into his subject, exaggerating, usually without thinking of it, some features that have impressed him, and ignoring others.

Such departure from truth is not necessarily wrong. Exaggeration, like all our tendencies, may have a good or a bad result, according to the use that is made of it. We reprehend it when it develops unpleasant traits into undue prominence, or when it imprisons us in inconvenient and unseemly garments. But when it emphasizes among the traits of our countenance those which are associated with intelligence, bringing out the forehead which thinks, augmenting the facial reliefs upon which emotion is expressed, and retiring the merely physical features, it offers an attractive ideal and one that should not be despised.

We are not wrong when we admire the beauty of those among us in whom the characteristics of our race are exaggerated. They possess in the highest degree those features which are in course of development, they represent the generations of the future, and are worthy, by this title, to be perpetuated.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

ENRICO FERRI ON HOMICIDE.

By HELEN ZIMMERN.

SECOND PAPER.

FERRI passes in review 1,711 individuals, of whom 711 are soldiers, 699 criminals, and 301 madmen. In this minute examination of anthropometric data he discusses almost every case, pointing out its specific characteristics by means of ample comparisons, which justify his methods of research and his conclusions, as well as throw light on the difficult and not yet firmly established study of criminal anthropology. To close this section of his learned work, he devotes a portion to the reaffirmation of the inferiority of criminal as compared with normal man, and to the analogy that certain anomalies and delinquent characteristics present, deducing thence criminal degeneracy. Very remarkable are the differences of cephalometric characteristics between a certain number of soldiers examined, among whom were some students. The superiority of the latter was incontestably proved by the great anterior semicircumference of the head, by the greater

cranial capacity, by the larger frontal diameter, and the minor development of the upper jaw. Worthy of note, too, in regard to this last point is the result of the examination of homicidal murderers as respects recidivistry. The former showed less cranial capacity and a minor frontal diameter, while their upper jaws were more developed.

Having examined these chronic anomalies in criminals in reaffirming the conclusions arrived at by the modern school of criminal anthropology, Ferri gives us the physiognomy of murderers in their characteristic traits, calling to aid the help of photography. It is an interesting series of pictures that he has thus grouped together. Here is the apish type; there the half-mad; there one with large jaws, the most characteristic and frequent feature; the type with receding forehead, etc. The study of temperament and of race in the order of delinquency, which represents the bio-psychic personality of an individual and of a people, is not yet well matured, as opinions with regard to their influences are many and varied. Still, some progress has been made. Thus it is popularly held that full-blooded, passionate, energetic temperaments are more prone to homicide, while the truth really lies in the opposite direction; the physiological character of this determination is rather a general denutrition of the organism and of the nervous system which originates that irritability and that lack of inhibition by which men react with more difficulty against the murderous impulse.

Race, whose marked influence in biological and social manifestations is, however, denied by many eminent scientists, is nevertheless one of the concurrent factors in the determination of a crime and one which can not be overlooked. Race is not the only factor in the distribution of homicide in Europe, for side by side with this run the social economical conditions induced in their turn by this very race. In this distribution there are manifest three distinct ethnographical groups—the Græco-Latin, the Germanic with the Anglo-Saxon, and the Slav—which stand for the three large zones of homicide. In the first place for the greater frequency of homicide stand the Latin peoples—Italy, Spain, Roumania, Portugal, France, and Belgium; in the medium zone the Slav people of Russia and Austria; for the minor frequency of this crime, the peoples of Germanic origin of Germany, Holland, and England. The sad supremacy pertains not to Italy but to Spain.

With this extended survey of the organic constitution of homicidal delinquents Ferri terminates the first section of his book. The second part is devoted to the study of the psychic constitution of the murderers. He first wisely clears the ground with regard to the interpretation of psychic data and the relations be-

tween ideas and sentiments in the genesis of homicide. In this place Ferri recapitulates his famous classification of homicides into madmen born; homicides habitual, by occasion, and by passion; and finds that among these types the most characteristic and marked are the homicides born and the insane homicides, with whom alone he is occupied in this volume.*

He then exposes with a large array of facts the most marked psychological characteristics of the born homicide which constitute his psychic condition before committing his crime. These characteristics are moral insensibility; insensibility toward the victim, toward the sufferings of others, a cold ferocity in the execution of crime, which is sometimes pushed to cannibalism; an apathetic impassibility after committing the crime and even in sight of the corpse of the victim; quiet sleep after the committal of the deed. These characteristics—indifference at sight of the sufferings and death of others—are extended to the personality of the murderer himself. Such persons are noted for their moral and physical insensibility with regard to themselves, which is sometimes pushed to the point of analgesia, to impassibility to their own punishment, to indifference to death, and which also manifests itself in the frequency of suicides among delinquents. They are also cruel and insensible toward their own accomplices, whom they will betray and even kill. This ferocity, this indifference, this insensibility, of born homicides, serve as a psychological explanation of other characteristics which are conjoined to these and which help to support these views. Indifference is chronic, manifesting itself also in a preoccupation with most trifling things quite outside of the crime committed or of a diverse character, and which certainly can not by any means be attributed to a supposed corruption during confinement. They feel no repugnance to the idea or to the act of homicide before the crime. They have no moral sense, they use expressions which pertain to honest work or expressions which ridicule their crime, which they regard as a simple transgression. They do not hesitate to boast beforehand of the crime they intend to commit, as though it would do them credit; and even admit that they are disposed to commit many more; they have not, in short, any remorse concerning their offense. To this absence of remorse, of which Ferri traces the differential characteristics, must be added the obstinate denial, the disinclination to repair the injury done or to repent, the indifference to escape punishment, the easy adaptation to prison life,

* The invention of this gradation and variety of types among criminals, certainly the most fecund and fundamental, so cleverly carried into the camp of criminal anthropology, has already been put forward by Ferri before the publication of this his latest work, and he has every right to be proud of it.

the indifference to the number of their condemnations, and, in more direct mode, satisfaction in the crime consummated or remorse at not having achieved their aim; and, finally, in many cases the explicit confession that they feel no remorse or repentance. However, the lack of repugnance to crime and of remorse can not be said to be universal and to manifest itself in every direction of criminal activity, because, excepting in those criminals who have never had either the one or the other sentiment for any species of offense, there is often verified a kind of moral Daltonism which, though lacking in criminals who, having a very obtuse moral sense of certain crimes, on the other hand have a most delicate perception. One among many salient examples is that of a thief who has a horror of homicide, and of the homicide to whom the thought of theft is repellent. This moral Daltonism extends also to the impelling causes, and to the execution of the crime, that is committed for one reason and rejected for another. It extends itself to the very instruments used to commit the homicide. It may also arise from caste prejudices, as, for example, in the man who killed his brother because they were both in love with their housemaid, and who cried out in the court, "You had every right to kill me, but none to dishonor me!"

It is thus in cold blood, so to speak, that Ferri studies the psychological constitution of born homicides and the manifestation of their moral sense. He also examines their sentiments. Religious sentiment is extraneous to the genesis of crime, and hence moral and immoral men are found indifferently among atheists and believers, though the number of atheists is rare among homicides, who, as a rule, have the religious sentiment highly developed, a proof of which is found, among other things, in being tattooed with religious symbols, their superstitious piety, and lastly their true and real religious cultus, even to seeking a comfort in crime and to finding a convenient faith in pardon. As a general rule, indeed, nearly all delinquents are deeply pious. The egotistic sentiment of homicide may be resolved into the forms of *amour propre* and the sense of enjoyment, including under the latter heading pride, vanity, love of display, vendetta, covetousness, and prodigality. Homicidal thieves have also other characteristics of the true homicide, such as a reckless squandering of money acquired by murder, a passion for play, for women, and for alcohol. The ego-altruistic sentiments or those purely altruistic, such as love, family affection, etc., are not lacking in homicides when they are not in conflict with the egotistic. Murderers are even not incapable of noble actions, but their immoral temperament renders these unstable and contradictory, and thus it may occur that the same altruistic sentiment finds expression in their very crime.

And this brings us to the last portion of this study concerning the psychic constitution of murderers—that is to say, to the intellectual element. We already know the cerebral inferiority of delinquents as compared with healthy subjects. This inferiority in the class of born homicides can not be better characterized than as a weak and incomplete association of ideas. The intellectual characteristic of mental weakness in delinquents does not exclude in some of them a certain degree of intelligence in other branches of mental activity—so much so that, according to Lombroso, there are found murderers who have talent, not to say genius. These, like all born homicides, have in common the lack of a moral sentiment; as regards intelligence, they may be classed under these two headings: The sanguinary homicide, *la bête humaine*, who kills more often for vendetta or for covetousness, and the calculating homicide, who kills for covetousness and for ambition, and is often endowed with brilliant intellectual qualities. Generally speaking, however, in all criminals, as a result of their defective association of repellent ideas, there is very marked improvidence. This improvidence is shown in many criminals by the carelessness with which they themselves reveal their misdeeds, the imprudent manifestations they are the first to give during and after the consummation of the crime, the careless manner in which they leave traces of it, the way in which they return to the site of their deed, as well as in not foreseeing the punishment. In others, instead, the art they adopt to render difficult the discovery of their deeds is very marked, and the percentage of the authors of crimes who have remained undiscovered is remarkable—twenty-five per cent in Italy on crimes that have been denounced, without counting the contingent of those where even the crimes have not been discovered.

As a conclusion of this positive examination of the born homicide, Ferri thus defines the fundamental psychological characters of these persons: "Abnormal impulsiveness of action for lack of or owing to weak power of resistance to criminal desires." In general, normal man, although subject to temptations and to momentary criminal impulses, fights against them. A case in point is that of the celebrated alienist doctor Morel, who, feeling himself suddenly impelled to the idea of throwing a workman who happened to stand near him into the river, fled from the spot. The born homicide can not thus defend himself. These facts, in which is delineated the embryo of that pathological homicidal obsession which our author now goes on to examine, can be explained by congenital weakness of development, the nerve centers having been arrested, and hence not apt nor educated to resist.

It may also happen that the delinquent does not complete his

crime; but this is usually due not so much to internal resistance (active inhibition) as would occur in normal man, as to an external and present force (passive inhibition), which hinders its execution, such as an unexpected incident which takes the place at times of this defect of inhibition, giving to the delinquent the resisting force which he lacks. And this brings us by a natural transition to insane homicide. The author arrives at the conclusion that there does not exist a special form of homicidal "monomania," but that all the forms of madness may be accompanied by homicidal excess. Hence the criterion that he has adopted in his symptomatology of homicidal mania. He differs from the classification that is purely clinical and descriptive, and frequently insufficient for the scientist as for the magistrate. His favorite genetic criterion of the initial idea and the action of homicide in the insane delinquent is very useful in achieving a good result from the important and very distinct comparisons between the delinquent and the criminal madman, and the delinquent and common or non-criminal madman. As a basis for this comparison it is necessary to distinguish the insane delinquent from the non-insane, a matter of deep importance not only for science but also for jurisprudence, because from this distinction arise the various degrees of imputability and the divers means of social defense to be adopted. It is further needful to distinguish in these madmen the insane conduct exclusively due to their intellectual degeneracy from that criminal one which is also due to the lack of the moral sense. In point of fact, in non-delinquent madmen the greater abnormities are to be found in the intellectual functions, while in the delinquent abnormities of the moral sense are most marked. Of course, this is a mere academic discussion, for a real and sharp natural distinction between the forms discussed can not exist, and the non-insane delinquent and the insane are fundamentally equal when it comes to be a question of criminal manifestations.

Let us now consider the psycho-pathological symptoms of homicide. Ferri, with his rich array of facts, of opportune elucidations and examples, undertakes this examination, dividing this last section of his book into two groups which deal with the moment of the homicidal act and the attitude of the insane murderer before, during, and after its execution and during his trial; and finally, as a last chapter, he adds the conclusions to be drawn from the antecedents of the criminal's life and the recidivity of the insane homicide.

The deliberation in this unhappy person is due either to the slow invasion of the homicidal idea (homicidal obsession) or to momentary impulse. Hence two distinct generic types of psycho-pathological characteristics. The first type, in which the decision

to commit the crime springs from a slow and reflective process which increases from the weak or static (obsession) state until it becomes an irresistible impulse and takes a violent and dynamic form, finding vent in the criminal act, is very frequent under the influence of the delusion of persecution, in chronic alcoholics, in hysterical subjects, etc., and is also seen in other non-violent forms of mental alienation. Sometimes the madman has a perfect cognizance of his own madness, so that he will often warn others as to the crime he intends to commit and knows the punishment due to it, and yet nevertheless this will not deter him unless fortuitous external causes intervene. In fact, it often happens that madmen affected by homicidal obsession, incapable of restraining themselves, afraid of themselves, in order not to yield to the homicidal impulse, take the precaution of wounding or mutilating themselves, in order thus to divert their ungovernable impulse, and render it impossible to execute their purpose. A case in point is that of a man who, unable to dominate the violent force impelling him to murder his wife and children, consigned himself to the police and had himself shut up in an asylum.

The second type, in which the determination to homicide proceeds from a spontaneous impulse (the transitory mania of the old school of psychiatry), from a species of impulsive vertigo, without a real impulse or motive, is found generally in epileptic subjects. This tyrannous impulse toward crime is also due very frequently to hallucination and illusion, often ignored by those who have to do with madmen. Homicide from hallucination presents three subtypes: first, that in which the madman acts under the terror of a fearful hallucination (epileptics, alcoholics, etc.); secondly, in consequence of delirium from delirious homicidal premises (persecution mania); thirdly, in obedience to the imperious commands of an inward voice. Nevertheless, this does not exclude the criminal motive (vendetta, jealousy, etc.) which sometimes determines the insane to commit homicide (especially the epileptics), motives which they readily, however, confess.

To complete the psycho-pathological characteristics as to the deliberate moment of homicide in the insane, Ferri treats of homicide as an end in itself or as a means toward a legitimate end, observing that if in mad homicides murder is an end in itself (killing to kill, impulse without motive) or as a means to an end, more often social and juridic (defense from imaginary perils, withdrawal of their victim from misery, etc.), in common madmen it is always a means to reach an antisocial end. This remark is all the more important because, besides refuting the ancient affirmation which is still repeated, that delinquents have always a motive for their deed, while madmen have none, it also refutes the other no less erroneous affirmation of Esquirol

that "in delinquents murder is a means, in madmen it is an end," adopted until now by most scientists, and only lately dismissed as inadequate by the most eminent anthropologists and criminalists in consequence of Ferri's criticisms published in 1886.

In the present book the author adds two other characteristic motive factors found in mad delinquents—that is to say, homicide for purpose of suicide (for example, a man kills another in order to expiate his crime on the scaffold); and sacrificial homicide induced by the desire to kill, to sacrifice a victim for his own good or for the good of both murderer and victim. This, according to Ferri, is the attitude of the insàne homicide before, during, and after his criminal excitement. First, and less common, there is the premeditation which approximates the insane homicide to the homicide born. The concomitants of this type may be the killing of his victim openly in the face of witnesses, the lack of accomplices, the latter an important feature and one that the mad homicide has almost always in common with the murderer by passionate impulse. It is not, however, unknown that madmen associate to commit crimes, from the sociability that is a characteristic of the epileptic, and forms indeed yet another proof of the fundamental identity of epilepsy and congenital delinquency with so-called moral insanity, so wonderfully demonstrated by Lombroso.

While committing the crime the manner of the mad homicide is generally agitated. He is also of a violent ferocity, which differs from that of the born homicide, which may lead him to the point of cannibalism, just as it does the latter. Another symptom, which is, however, exclusively seen in the insane (imbeciles, idiots, epileptics), is that of the monstrous sexual passion that finds its vent on the corpse of their victim (necro-philomania), to which must be added the murder of persons beloved or of persons unknown, as well as indiscriminate massacre.

The symptoms and the attitude of the mad homicide after his crime are in part common to those of the born homicide, although the psychological genesis of these symptoms is different. These are: calmness after committing the act, which often continues when arrested and during the trial, impassibility at sight of the corpse, etc. A true characteristic symptom distinguishing the mad homicide from the born homicide is great prostration and abnormal sleep into which he often falls after his murderous assault, very different from the calmness and the placid sleep of the born homicide. Notable, too, is the impulse toward suicide that seizes him immediately after the consummaticn of the deed, an instantaneous reaction of his moral sense, the feeling of relief, as though a heavy weight were removed, the moral Daltonism

and the moral valuation of the crime which may rise to the point of true remorse.

The characteristics of the attitude of the mad homicides during their trials are the frequent energetic protests that they are not mad, the dissimulation of their insanity or even the simulation of another form of madness different from that from which they suffer, the nonresistance when arrested, the instinctive attempt at flight, and the *alibi* they prepare for themselves in cases of premeditation; their frequently detailed confession, often made in phrases such as "It was not I. It was my head. I was blinded by my illness. I felt a blow on my head," and so forth. Or when, like other delinquents, they are not anxious to invent excuses for themselves, they either do not excuse themselves at all, or even accuse themselves of imaginary crimes, as though they wished to make themselves out worse than they are.

Ferri finally proceeds to analyze very carefully the groups of symptoms regarding the life of the criminal before and after the committal of his crime as well as his hereditary antecedents. The previous conduct of the born homicide is often very regular; and then suddenly, a little before the murder, a change of life and character will take place. Another characteristic sometimes is the perpetration of other crimes after the first homicide.

Following this last research Ferri gives us in conclusion the most important deductions which result from this portion of his great work, as to the psychical constitution of the born homicide and the mad homicide. He sums them up into twelve axioms, which should prove of invaluable use to the judicial authorities. These it is not easy to condense, and for their precise formula we must refer our readers to Ferri's book.

Crime is always a decided condition. This is the final and lucid outcome of his learned work, a conclusion at which Virgil and Lombroso respectively arrived, and a conclusion that honors these thinkers. In his future volume he promises to treat of the two other typical figures of homicides from passionate impetus and homicides from occasion, to which we look forward. One important point Ferri touches but slightly, and that is, Is crime nowadays the exception or is it not rather the rule? It must unfortunately be concluded that it is the rule in the actual epoch Europe is traversing; this does not mean, however, that crime is a normal phenomenon, but only helps to confirm the innate relations that exist between economic conditions and criminal facts, or rather, in Ferri's own words, "that the present social crisis has reached such a point as to render even criminal symptoms acute and profound, which does not exclude that in a more advanced phase of social order, such as scientific socialists look forward to, crime, like every other symptom of social pathology, will be re-

duced to the smallest proportions, such as occurs to common illnesses on the cessation of a more or less prolonged epidemic."

This book Ferri has dedicated to his little three-year-old son Dante, expressing the hope, as he says in his dedication, that when he is old enough to understand it, Italy may show fewer signs of moral pathology. It is certainly a remarkable work, and reflects great credit on its writer by its minute and impartial research.

SKETCH OF ROBERT EMPIE ROGERS.

FOR the facts in the life of ROBERT EMPIE ROGERS, as well as of the other members of this family famous in science, the memorial paper of the late Dr. W. S. W. Ruschenberger is almost our only authority. Robert Empie Rogers was the youngest of the four brothers, sons of Patrick Kerr Rogers and Hannah Blythe, whose researches, several and joint, have conferred so much honor on the name. He was born in Baltimore, Md., March 29, 1813, and died in Philadelphia, September 6, 1884. His father having been called to be Professor of Natural Philosophy and Mathematics in William and Mary College, removed to Williamsburg, Va., in 1819. There his mother died in the next year, when Robert was seven years old, and the boys, Dr. Ruschenberger says, "became almost foster children in the families of the professors." Robert seems to have received special care at the hands of the Rev. Adam P. Empie, D. D., and his wife, and in recognition of that care assumed the name of Empie. He was taught by his father, and after his death by his brothers James and William. The profession intended for him was that of engineer, and he began the exercise of it as an assistant in the survey of the Boston and Providence Railroad. Nothing is known about the engagement or the work done by young Rogers, except that the results of it were not satisfactory. In a letter written to his brother William in 1833, Robert expresses doubt of his prospect of success if he should try engineering again, and confesses that his favorite desire had always been to become an instructor. Civil engineering was given up, and Robert, having determined to study medicine, became a pupil of Dr. Robert Hare, Professor of Chemistry, "and worked zealously in his laboratory till the close of his undergraduate course." He was graduated from the Medical Department of the University of Pennsylvania in March, 1836, offering as his thesis a paper on "Experiments on the Blood, together with some New Facts in regard to Animal and Vegetable Structures, illustrative of many of the most Important Features of Organic Life." This thesis was published, with illustrations, in

the American Journal of the Medical Sciences. He, however, preferred chemistry to medicine, and served from 1876 as chemist of the first Geological Survey of Pennsylvania, under his brother Henry, who was chief of the survey. In this position he was associated with James Curtis Booth and John F. Frazer as the other assistants.

In the fall of 1841 he was invited to the University of Virginia to take the place in teaching the chemistry classes of Prof. John P. Emmet, who was ill. Prof. Emmet not recovering from his illness, Mr. Rogers was in March, 1842, elected in his place Professor of General and Applied Chemistry and Materia Medica, a position which he held with credit till 1852. In August of the latter year he was elected Professor of Chemistry, in the place of his brother, James B. Rogers, deceased, in the University of Pennsylvania. In 1856 he became Dean of the Medical Faculty of that institution. In July, 1862, during the civil war, he was appointed acting assistant surgeon in the Army of the United States, and assigned to duty in the Military Hospital at West Philadelphia, where he served not quite one year. At his suggestion a steam mangle was set up under his supervision in the neighborhood of the hospital. On the day it was completed he was showing a woman how to feed it safely, when his right hand was caught in the machinery and crushed. He was able with his other hand to throw the machine out of gear and stop it, but while a workman was lifting the cylinder, weighing eight hundred pounds, from off the disabled hand, the great piece slipped from the crowbar and fell upon it, aggravating the injury it had received. He was anxious lest his wife should be seriously shocked by too quickly realizing the severity of the mutilation he had suffered, and, to prevent this as far as possible, he left the carriage in which he was conveyed a short distance from his house and walked home. The hand was amputated by Prof. Smith, of the university, and its place was supplied for a time by an artificial hand. "Almost ambidextrous prior to the accident," says Dr. Ruschenberger, "he speedily learned to write with his left hand and to use the right arm, beneath the shoulder, in prehension with notable skill in his experiments while lecturing."

About this time the United States was swept by the "oil fever," and visions of wealth to be suddenly acquired by the possession of a well turned many an otherwise well-balanced head. Prof. Rogers did not escape the epidemic; and the fact that a man so well informed in scientific matters as he was associated in the enterprise contributed no little to the success of the scheme for organizing the Humboldt Oil Company in February, 1864, to which a capital of a quarter of a million dollars was contributed. Organization was all the success the company had. Land was

bought, wells were dug, and the work was carried on for some time without profit; and finally, in 1873, the whole concern was sold out, a nearly total loss to the shareholders. Prof. Rogers was the largest holder, having one fifth of the shares, and lost more than any of the others.

In 1872 Prof. Rogers was appointed, with Dr. H. R. Linderman, by the Secretary of the Treasury, a committee to make examinations in the mint at Philadelphia for the purpose of ascertaining the extent and sources of a waste of silver that was alleged to be taking place there "in excess of the amount tolerated by law." The processes of assaying and refining the bullion and converting it into coin were carefully tested by numerous experiments at the mint and at the Assay Office in New York. About two months were spent in the examination. The result of it was presented July 25, 1873, in a well-considered and elaborate Report on the Wastage of Silver Bullion at the Melter and Refiner's Department of the Mint. This investigation, valuable in itself, was also valuable in its consequences, because it suggested modifications in the method of refining the precious metals which were afterward adopted. The Director of the Mint said in his annual report that the results obtained were conclusive of several points, and would be valuable in future minting operations. Prof. Rogers next made an examination of the working of the mint at San Francisco, concerning which he reported to the Director of the Mint. In 1874 he experimented at the Assay Office in New York concerning means of ridding the establishment of inconveniences suffered from acid vapors. "Prior to that time nitrous-acid fumes, arising from the nitric acid used in refining silver, were allowed to escape through the chimney into the open air, seriously annoying neighbors. To correct the evil, Dr. Rogers had constructed in the attic of the building a furnace for burning coke, into which the fumes were conveyed and burned." Instead of extinguishing, these fumes promoted the combustion of the fuel. He afterward conferred with the Treasury authorities in Washington concerning plans which he had proposed for the equipment of a refinery in the mint at San Francisco. The plans, which included a sulphuric-acid process recommended by him, and the erection of additional buildings, were carried out under his supervision, and the completed work was put in charge of the superintendent in August, 1875. "At the suggestion of Dr. Rogers during the progress of the work, an artesian well was sunk within the hollow square of the mint, which supplies one hundred thousand gallons of water daily for all the uses of the establishment." The succeeding report of the Director of the Mint mentions the advantage to the public interests which attended the operation of the refinery. In connection with this work in the mint Prof.

Rogers also made a careful investigation and estimation of the probable total production of the Consolidated Virginia and California Mine in Nevada. He was further, from 1874 to 1879, or for about six years, a member every year of the Annual Assay Commission. He was for twelve years one of the chemists to make an analysis and daily photometric test of the illuminating gas supplied to Philadelphia.

In 1877 Prof. Rogers was elected Professor of Medical Chemistry and Toxicology in Jefferson Medical College; and, to accept the offer, resigned the position which he had for a quarter of a century held in the university. His entrance into this institution was the occasion of a flattering demonstration at the time of the opening of the course of 1877–'78 with an introductory lecture. "It was estimated that not less than twelve hundred physicians, students, and others were crowded into the hall. At the conclusion of the lecture a silver vase was presented to him as a token of the respect felt for him by the great class of medical students."

Prof. Rogers became a member of the Academy of Natural Sciences of Philadelphia in 1837; was interested in its proceedings through most of his life; attended its meetings at irregular intervals for many years in succession; participated in its discussions, and delivered lectures to promote its interests. Many of his verbal communications are noted in its proceedings from 1859 to 1862. He was a member of the Franklin Institute from April, 1838, except when living away from Philadelphia; became a life member in 1855; one of the Board of Managers in 1857; was one of the vice-presidents for seventeen years from 1858; was chosen president in 1875; and on retiring from that office in 1879 was returned to the Board of Managers for the rest of his life. "He was particularly active in the work of the institute, delivered courses of lectures on chemistry before its classes, assisted in the management of its public exhibitions, served on several of its standing and on many of its special committees, the most notable of which were one on tests of the efficiency of dynamo-electric machines, and another on the dangers of electric lighting." At the celebration of the semi-centennial anniversary of the foundation of the society, February 5, 1874, he delivered an address on the history of scientific discoveries and their practical applications in the half century, in which he pointed out how the work of the institute had contributed to the progress of science and the diffusion of knowledge.

He was elected a member of the American Philosophical Society in 1855 and a member of its Council in 1859. He was a frequent attendant at its meetings, served on several of its committees, and often took part in its discussions. He was less often present at the meetings of the College of Physicians, of which he

was elected a Fellow in 1857. At one of these meetings, according to Dr. Ruschenberger, he related an incident in the case of a trial for poisoning He, as an expert witness, contributed to the establishment of the fact that the subnitrate of bismuth sold in the drug stores was contaminated with arsenic, which had not previously been suspected. He became a permanent member of the American Medical Association in 1852, when he attended the meeting at Richmond as the representative of the University of Virginia. He represented the University of Pennsylvania in the meetings of 1853 and 1872, representing also at the latter meeting the medical profession of Philadelphia, and delivering the address of welcome to the delegates. He took an active part in the formation of the Society of the Alumni of the Medical Department of the University of Pennsylvania, and was its treasurer for several years. With his brothers Henry and William he took part, in 1840, in the organization of the Association of American Geologists and Naturalists, which afterward became the American Association for the Advancement of Science. The catalogue of his writings includes four papers under his own name alone in physiology, chemistry, and metallurgy; twelve papers by him and William B. Rogers in chemistry; a paper on the analysis of magnesian limestone by him and Martin H. Boyé; three papers by Dr. H. R. Linderman and him in metallurgy and electricity; a paper by James B. Rogers and him on the alleged insolubility of copper in hydrochloric acid; and seven papers by William B. Rogers and him on subjects in chemistry and meteorology. He also edited the American edition of Lehmann's Physiological Chemistry, which was published in 1855; and he was joint author, with James Blythe Rogers, of a text-book of inorganic and organic chemistry, compiled from the works of Dr. Edward Turner and Dr. William Gregory, which was published in 1846. Besides his regular occupations, Prof. Rogers was sometimes engaged as an expert in criminal trials; frequently delivered lectures, illustrated by experiments, for the benefit of institutions; and often did works of kindness and benevolence. Three instances are mentioned in which he heroically saved persons from drowning. He had a remarkable faculty, Dr. Ruschenberger says, in the use of tools of all kinds, and a respectable talent for mechanical contrivance. He was author of many inventions—notable among them the Rogers and Black steam boiler—and of several modifications and improvements of electrical apparatus. This ability was early manifested, in 1835–'36, in his original experiments on osmosis, in which he demonstrated how changes in the blood are produced by respiration.

Correspondence.

WOMAN'S CLAIMS TO THE BALLOT.

Editor Popular Science Monthly:

Sir: The "antagonism of the sexes" suggested in your criticism of my paper on Woman and the Ballot, in the June number of the Monthly, must have been read between the lines, as I have not the least feeling of that nature to betray.

I confess, however, that I have a passionate love of justice which is apt to be aroused by any attempt to forestall judgment such as was made by Mrs. Linton and Mr. Talbot in announcing the *raison d'être* for woman. Believing, as I do, that neither they nor any one else can give one iota of proof in regard to "causes of existence," whether of an *amœba* or woman, a little irony is pardonable.

No attempt whatever was made to give the important arguments in favor of woman suffrage, as these were ignored in Mr. Talbot's article, his efforts being mainly directed to the testimony of "Nature" against a feminine share of government.

One of the best reasons I can urge for the gift of the franchise to woman is its educative effect upon herself. I hold strongly to the doctrine of *personal* responsibility, and think enough evil has been accomplished by "trusteeship," however generously and conscientiously it may be exercised in particular instances.

The special laws referred to as resultants of woman's effort were: The bill granting property rights to women in the State of Vermont, October, 1847; the removal of disabilities from the women of Kansas in 1859; and the granting of property rights to the women of Connecticut in 1877. The testimony in regard to these is as follows: "From 1843 to 1853, inclusive, I edited The Windham County Democrat, published by my husband, George W. Nichols, at Brattleboro. Early in 1847 I addressed to the voters of the State a series of editorials setting forth the injustice and miserable economy of the property disabilities of married women. In October of the same year Hon. Larkin Mead, of Brattleboro, 'moved,' as he said, by Mrs. Nichols's presentation of the subject in the Democrat, introduced in the Vermont Senate a bill securing to the wife real and personal property with its use and power to defend, convey, and devise, as if sole. The bill as passed secured to the wife real estate owned by her at marriage," etc.*

In 1859 Mrs. Nichols addressed the Constitutional Convention in Kansas upon equal legal and political rights for women. Three of the four petitions presented by her were granted, the report being adopted by a solid vote of the Democrats and enough Republicans to make a majority.*

The Connecticut law of 1877 giving property rights to women was passed upon Governor Hubbard's recommendation, who, in a personal letter to Mrs. Isabella Hooker, acknowledged her influence. "Thank yourself and such as you for what there is of progress in respect to woman's rights among us." †

If these women did not supply the motive power that stimulated the sluggish masculine "sense of equity and right," then we are wrong in ascribing causative value to any pleading. It is not a case of *post hoc, propter hoc*, merely; it has the connection of the match and the flash.

As for all generalizations concerning the mental characteristics of women, I think we have as yet no adequate data, and therefore that all books founded on such premises are entirely valueless from a scientific point of view. Alice B. Tweedy.

New York, *August* 25, 1896.

A CORRECTION.

Editor Popular Science Monthly:

Dear Sir: On page 569 of the August number of the Monthly E. W. Moir makes the statement that he treated certain cases "homœopathically." The cases were patients suffering with what has been called "caisson disease." The cause of this disease is the too sudden removal of supernormal atmospheric pressure, or the too rapid removal of one from a chamber of compressed air.

To relieve the paralysis thus caused we are told that the patients were again put into a heavy atmosphere. As it was the removal from a heavy atmosphere that caused the disease, certainly reintroducing a patient into a heavy atmosphere can not be called homœopathic treatment. There are many others who misuse medical terms quite as recklessly as the word "homœopathically" is in the instance mentioned above.

Respectfully, J. M. G. Carter, M. D.

Waukegan, Ill., *August* 1, 1896.

* Reminiscences of Clarinda I. Howard Nichols, History of Woman Suffrage, vol. i, p. 175.

* History of Woman Suffrage, vol. i, pp. 192, 193.

† History of Woman Suffrage, vol. iii, p. 326.

Editor's Table.

ANOTHER BISHOP ON SCIENCE TEACHING IN ELEMENTARY SCHOOLS.

WE were not a little surprised to read in Nature some time ago an article from which it appeared that Bishop Temple, of London, had, in an address delivered before the Diocesan Conference, expressed his entire opposition to the teaching of science in elementary schools. So far as these schools were concerned he would be glad, he said, "if all these scientific subjects were got rid of entirely." Now Dr. Temple, as Nature observes, is an experienced educator. He was Head Master of Rugby at the time when he wrote his celebrated paper on The Education of the World in Essays and Reviews ; and he has also been an inspector of schools and principal of a training college. He may therefore be supposed to know a good deal about education; and we can only regret that we are not in possession of a fuller statement of his views than we find in the columns of our contemporary, as it is difficult to believe that he could have expressed such opinions as those quoted without qualification. Nature, replying to the bishop, proceeds to show how important technical knowledge is to the commercial prosperity of nations. This does not fully meet the case, however : technical knowledge may be, and is doubtless, of the highest importance to a nation's commercial prosperity; and yet from an educational point of view it might (conceivably) not be advisable to introduce science into elementary schools. The question is not as to teaching science, but as to when to begin to teach it and how to teach it in the earliest stages.

If Bishop Temple, who has always been regarded as a very enlightened man, means no more than that science should not be so taught to young children as to tyrannize over their thoughts and cramp their imaginations, we could agree with him. If, on the other hand, he means that there is no way of introducing the teaching of science with advantage into the education of the young, we can only consider him seriously mistaken, and regret that he should have given the weight of his authority to a very hurtful idea. Many of our readers are doubtless aware that some eminent scientific authorities have been profoundly dissatisfied with the methods and results of science teaching in the elementary schools both of this country and of England. In spite of their predilection for scientific studies they have been forced to acknowledge that, somehow or other, science as actually taught seemed in a great many cases to possess little or no educative value. The late Prof. Huxley was very strong on this point, maintaining that the fault lay in the excessive use made of text-books and the overloading of the mind with facts which it could not properly assimilate. Bishop Temple may have witnessed a similar phenomenon; but, if so, the inference to draw is not that there is no place for science in elementary education, but that its true place has not always been understood, or that those who have assumed to teach it have not possessed the skill and insight necessary to bring it into vital relation with the minds under their charge.

As we take it, the business of science in early education is not to go

rudely counter to all the natural ideas of a child in regard to the universe, nor to impose upon him at once the somewhat oppressive conception of unvarying law, but to cause the idea of law to steal gradually into the mind, and to reveal and assert itself more and more through the successive observations which a judicious teacher will lead the child to make. Childhood, it should be needless to remark, is a period of great outward activity—a period when impressions from the world around are crowding in on the mind; it is not to any great extent a period of reflection ; and any studies, therefore, which make a premature or excessive demand on the reflecting powers can not fail to do harm. The youngest child will generalize to some extent—that is to say, will do it fitfully and in regard to familiar matters; but wide generalizations in regard to unfamiliar matters lie outside of its natural sphere; and, if forced on its attention, will not only fail to interest, but will, in direct proportion to the insistence of the teacher, depress the whole play of the mental faculties and injuriously affect the development of the physical system. This is a point where many teachers go astray. Generalizations are so interesting to the adult mind, they seem to help it forward so powerfully, and to be as it were so self-luminous, that a teacher requires to possess more than the usual amount of comprehension of and sympathy with the child mind in order to recognize that they are, in the main, unsuited to the latter, and therefore only to be applied sparingly in its education. This, we conceive, explains why "clever" people, so called, often make but inferior teachers of the young. In spite of all the psychology and pedagogics they may have absorbed—perhaps occluded—they can not sufficiently and permanently, day in and day out, distinguish between the mature and the immature intellect.

Science, like everything else, to be taught successfully needs to be taught with sympathy. There should be sympathy with the subject as well as sympathy with the pupil. The reason why, in the hands of certain teachers, language and literature prove so stimulating as studies, is that the teachers feel them to be related to the higher operations and finer perceptions of the mind, and succeed in conveying this idea to those whom they instruct. The teacher of science should not be content to occupy any lower ground. The laws and facts which he expounds have their own correlation with the past history and future destinies of mankind, and with the whole compass of human thought. In dealing with the young we should endeavor to humanize science as much as possible, and to present it as having its origin in the everyday impressions of sense, and as being in its essence merely an improved and beneficent interpretation of the world in which we live.

Unless the Bishop of London is a far more reactionary person than we take him to be, what he would banish from elementary schools is just what we would ourselves banish, had we the power, namely, that formal, didactic, authoritative instruction in the facts and theories of science which is more adapted to wither than to nourish the youthful mind, not such teaching as takes the form of a gradual and sympathetic introduction to the true order of Nature. Science is just as good for the young as for the old, on the one condition that those who teach it are themselves scientific enough to understand the minds they are dealing with. And the advantage of begin-

ning betimes is that the mind early accustomed to view the universe as an infinite field of knowledge, and science simply as a method tested and proved by experience for acquiring knowledge, is placed once for all in the right relation and attitude to all questions demanding the exercise of thought. Many men of eminence in letters have expressed regret that they did not enjoy this advantage in early life; and on every hand we see proofs that the lack which they have deplored is precisely the lack under which others are laboring, without, however, a saving consciousness of their deficiency. We want more science, not less, in education, but the science must itself be scientific.

THE FOURTH BUFFALO MEETING OF THE AMERICAN ASSOCIATION.

THE meeting of the American Association in Buffalo—its fourth meeting in that city—was eminently satisfactory from a scientific point of view, and was marked by many features of interest. About four hundred members were present. Among them were two of the six founders of the association still living—Dr. James Hall, and Prof. Charles West, of Brooklyn—whose presence was fittingly mentioned by President Morley in opening the meeting. Later in the sessions a kind of jubilee meeting was held in the Geological Section in commemoration of the sixtieth anniversary of Prof. Hall's work in connection with the New York Geological Survey, when addresses were made by Prof. Joseph Le Conte, W J McGee, and others, in which special features of the survey were presented. The address of welcome by the mayor of the city was supplemented by a greeting from Dr. Roswell Park, of the Buffalo Academy of Natural Sciences, on behalf of the scientific life of the place. Buffalo—a commercial city—has no great scientific institutions, but several of modest pretensions, including its university of five professional schools, which has just celebrated its semi-centennial; a second medical school; several libraries; the academy, which boasts of its special collection relating to the American bison; and a number of smaller affiliated clubs, each devoted to some particular form of the study of Nature.

President E. D. Cope, replying to these addresses, spoke of the insignificance of our knowledge as compared with what we do not know, of the value of original research, the nature of scientific investigation, and the objects of the association. The address of retiring President Morley was on the subject of A Completed Chapter in the History of the Atomic Theory. The addresses of the sectional vice-presidents were mostly technical discussions of special topics in their several fields, but some, which we shall mention in another place, offered points of considerable general interest. A similar remark may be applied to the papers in the sections, which offered great variety in character. The proceedings of the Economic Section were marked by the discussion of monetary questions in papers by Mr. William H. Hale and Edward Atkinson; Mr. Stillman Kneeland's paper on Citizenship, its Privileges and Duties; and papers bearing on the "woman question." Studies of Indian life were presented in the Anthropological Section, and an air of realism was imparted to the matter by the opening of an Indian burial chest, found in Michigan, and the exhibition of other specimens. The Geological Section paid much attention to caves. The results of cave exploration in the United States and their bearing on the antiquity of man

were presented in an illustrated lecture by Prof. Cope and Mr. H. C. Mercer; and the making of the Mammoth Cave was explained, and a colossal cave discovered a year ago in Kentucky was described by Prof. Hovey. The last gentleman urged the formation of an American cave club. The section resolved to place a tablet on the spot where the Association of American Geologists was founded. In the Section of Mechanical Science Mr. W. S. Aldrich advocated a national endowment for engineering research, and the subject of irrigation for the eastern United States was brought to attention. The practical side of chemistry was presented in such subjects as The Chemical Problems of the Pottery Industry, Sugar-making at the Present Day, and The Use of Coal-Tar Products in Food.

In choosing Prof. Wolcott Gibbs as the president of its next meeting, the association has honored itself in honoring a veteran chemist who was famous when the majority of its present most active members were still schoolboys.

Scientific Literature.

SPECIAL BOOKS.

We have here a popular view of one division of the fruitful field that is being worked by the physiological psychologists of the present generation in Italy.* The author lays a broad foundation for his treatment of his subject by describing the general functions of each part of the brain and those of the spinal cord. He then takes up the circulation of the blood in the brain during emotion, on which he has made extended researches. He has had opportunities to take tracings from the pulsations of the brain in patients whose skulls had been fractured, and shows that any sound or sight that stimulates mental action increases the quantity of blood sent to the brain. He has tested the same thing also with a balance devised by him which has a beam large enough for a person to lie at length upon. Any mental excitement of the subject on the balance inducing a rush of blood to the brain would cause the head end of the delicately poised beam to sink. When the normal condition of the subject was restored the balance would regain its equilibrium. Dr. Mosso has also taken many tracings from the respiration, the beating of the heart, and the circulation of blood in the hands, each class of records showing the perturbations produced by excitement. The variation in the quantity of blood sent to the hands and other outlying parts of the body underlies the phenomenon of pallor, which with oppression of the chest and quickened beating of the heart are among symptoms of fear. Trembling is another one of these symptoms which Dr. Mosso examines. Taking up facial expression, he describes the nervous and muscular actions by which expression is produced, and follows this with a chapter on the physiognomy of pain, in which he gives a series of photographs of a hospital patient undergoing a

* Fear. By Angelo Mosso. Pp. 278, 12mo. London, New York, and Bombay: Longmans, Green & Co. Price, $1,75.

painful manipulation of the arm. He also considers the expression of pain in the faces of certain classic pieces of statuary. Pain is not fear, and this interesting chapter seems to have been introduced as a substitute for material that it was not practicable to obtain. Opportunities for observing fear in children, both in their waking and sleeping hours, are not so rare as in the case of adults. Our author discusses both hereditary or instinctive and induced fears of little folk and gives some suggestions as to education for courage. Other aspects of his subjects treated in the closing chapters are the influence of fear on the skin and excretions, the paralyzing influence of terror on man and animals, and the maladies and even cases of death which great fright has produced. The treatment is popular throughout, and some of the author's descriptions—for instance, those of stage fright and delirium tremens—rise to the picturesque. It contains many things that a reader would want to refer to after a first reading, but its translators do not seem to think so, for they have left it without an index.

Mr. *Conant* has added to the literature of the banking business a notably convenient and instructive book.* His record begins with banking in Italy, in which country the bank that is considered to have been the oldest, that of Venice, was founded. This is followed by accounts of banking operations in the other countries of Europe. Coming to America, he gives a chapter each to the Bank of the United States, the State banking systems, and the national banking system now in operation. The banks of Canada, Latin America, Africa, and the East also receive attention. While the author has not departed from his historical plan so far as to write a treatise on banking, yet he does not refrain from characterizing the good and the bad features of the systems that he describes. He rates the Scotch system of banks of issue as coming "nearer to the ideal of successful free banking than that of any other country," and shows that the Canadian banks were founded on Scotch models, and the first one of them largely by Scotchmen. He also gives in his first chapter a brief statement of the theory of a banking currency, and concludes the volume by setting forth the chief advantages of such a medium. Many persons who are most firmly resisting the present agitation for a change in the coinage system of the United States are convinced that a modification of our method of issuing paper money is urgently needed. Mr. Conant shares this conviction, and in the chapters just mentioned, as well as in the one especially devoted to our national banking system, he vigorously affirms the superior elasticity of bank currency over issues of Treasury notes, and condemns many of the existing restrictions on the circulation of banks as unduly burdensome.

Another historical division of the volume relates to crises—the earlier and later ones of the present century, including that of 1893—with a discussion of the causes of these catastrophes. The tendency of the work is to reveal the operation of natural laws in monetary affairs, and to show that legislation that conflicts with these laws always works mischief.

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* A History of Modern Banks of Issue, with an Account of the Economic Crises of the Present Century. By Charles A. Conant. Pp. 595, 8vo. New York and London: G. P. Putnam's Sons. Price, $3.

GENERAL NOTICES.

In her recent volume, the fourth of the Memoirs of the American Folklore Society, Mrs. *Bergen** has brought together and classified fourteen hundred and seventy five different superstitions, thus giving us the most complete collection in English. When it is known that this arduous task was accomplished during years of invalidism, and is, moreover, but the first installment of the matter in hand, we marvel at the industry of the author. The items are arranged in nineteen chapters, covering the range of current belief under the headings Babyhood, Childhood, Physical Characteristics, Projects, Halloween and other Festivals, Love and Marriage, Wishes, Dreams, Luck, Money, Visitors, Cures, Warts, Weather, Moon, Sun, Death Omens, Mortuary Customs, and Miscellaneous. What memories of childhood are aroused at the forms of asseveration, such as "Honor bright," "Hope I'll die," etc., used to bolster up some unsteady tale, or the terrible imprecation against disloyalty:

> Tell tale tit,
> Your tongue shall be slit,
> And every dog in our town
> It shall have a bit!

A deeper interest is added when we think that these childish formulæ are but parallels of the more serious rites of savages, and link the play of the one to the horrible incantations of the other. Of the augury of the daisy petals—

> He loves me, he loves me not—

nine variants are given. Other interesting kinds of "projects," or "trying fortunes," are connected with apple seeds, bed, buttons, four-leaved clovers, stars, water, etc. The fifty or more signs and charms for the causes and cures of warts will be welcome to sufferers from that affliction. To the student of comparative mythology the solar and lunar beliefs will offer many links to the Aryan stock. In fact, it is the study of relationships which gives most value to this or any work of folklore. The introduction and notes by Mr. Newell are written with the usual care and clearness of this investigator, and add an invaluable guide to the interpretation of the superstitions. Mr. Newell says: "In commending this collection to the attention of psychologists, and to the continuing industry of students of folklore, I need only express my hope that it may be sufficient to make clear how far-reaching are the studies for which folklore supplies material. The history of religion, the theory of mythologies, can not afford to overlook modern popular beliefs, in which ancient conceptions appear as still effective."

* Current Superstitions. Edited by Fanny D. Bergen. With Notes, and an Introduction by William Wells Newell. Pp. 161, 8vo. Boston: Houghton, Mifflin & Co. Price, $3.25.

Dr. and Mrs. *Le Plongeon* spent twelve years among the ruined cities of the Mayas in Yucatan, living with the people, and are confident that they have mastered the Maya language, and learned to read the inscriptions traced in it. They have made the study of the subject the chief occupation of their lives. One who talks with Dr. Le Plongeon will hardly doubt that his assertions are sincere. From his studies of the Maya records, and his comparative studies of Eastern archæology and mythology, he draws most startling conclusions. Among those developed in this book * are the historic reality of the story of the Atlantis, and the ascription of an extreme antiquity and an extensive and potent influence to Maya civilization. When Egypt and Accad were young, or even before, he believes, the Mayas were living in Yucatan, a civilized people, with arts and architecture as we see them illustrated in the ruins at Chichen and other mysterious cities, while their colonists swarmed in Egypt and Babylonia and all the East, and left imperishable marks on the civilization and the languages of all those countries. This intercourse ceased with the catastrophe of Atlantis, which made the ocean unnavigable for thousands of years, and the story of the Mayas was forgotten. Much space is given in the book to the de-

* Queen Móo and the Egyptian Sphinx. By Augustus Le Plongeon. New York: The author, and the Metaphysical Publishing Company, 503 Fifth Avenue. London: Kegan Paul, Trench & Co. Pp. 277, 4to, with two portraits and 73 photographic plates.

velopment of arguments in support of these views from verbal analogies—the most delusive of all bases for the foundation of a theory. What the author claims to derive from the study of Maya documents is entitled to more serious consideration. This is the story of the ancient Maya queen Móo, whose brother and husband, Prince Coh, was treacherously murdered by his brother Aac. Queen Móo built a magnificent mausoleum to her consort at Chichen, the ruins of which still exist and have been explored and studied by Dr. Le Plongeon, who has recovered and possesses the charred heart of the prince, and the stone spear heads with which he was killed. Queen Móo, having refused to marry her husband's murderer, was obliged to flee from her country, and sought refuge on one of the islands of the sunken Atlantis. Here the Maya record stops; but Dr. Le Plongeon infers, from his Egyptian studies, that not finding the refuge she sought, she went on to Egypt, where she was warmly welcomed by Maya colonists and became influential. Her name, the author affirms, is preserved in that of the Egyptian Queen Mau; her story, with that of her murdered husband, became the myth of Isis and Osiris; and she caused the Sphinx to be carved as a memorial to her husband. Dr. Le Plongeon finds the story of Atlantis fully recorded on a stone which is preserved in Chichen, "as intact to-day as when it came from the hands of the sculptor," and also in the manuscript Troano and the Codex Cortesianus; and he further affirms that it was embodied by a Maya living in Greece in the Greek alphabet, the names of the letters of which, as recited by students, each represent one of the lines of the poem. Dr. Le Plongeon's theories are utterly at variance with those of the recognized Americanists; but if he errs, it is not from ignorance, for if he can read ancient Maya, he knows more than all of them, and his other reading has been amazingly wide. There is, however, the possibility that he has been carried away by an unbounded enthusiasm.

In his work on *Wages and Capital*,* Prof. *Taussig* inverts the usual order of proceedings by presenting his own views first, in five chapters, and reviewing the history of the wages-fund discussion from its beginning to the present, in the chapters that follow. This he does because criticism and comment proceed inevitably from the thinker's own point of view, and the proper estimation of their value depends largely on the reader's knowing what that is. In the first five chapters (author's view) it appears that all wages are paid from the products of past labor, and that the supply of products of past labor exists mainly in the form of real capital; that the class of hired laborers derive their wages from capital in this sense, and are dependent for their share of the real income, into which capital steadily ripens, on the funds which the employing class find it advantageous to turn over to them. The inquiry is then made whether the capital from which wages come is rigid or elastic, with a conclusion against rigidity. The inquiry results in the conclusion that the old doctrine of the wages fund had a solid basis in its conception, incomplete yet in essentials just, of the payment of present labor from past product. The theory thus arrived at shows the steps by which the wages get into the laborer's hands, describes the machinery of production and distribution, and so points to the nearest and most obvious causes which affect them; but it does not tell the whole story. In the critical review forming the latter part of the book, which begins with the writers before Adam Smith and includes contemporary discussion, the vogue of Mr. George's Progress and Poverty is declared not due to any solid or consistent reasoning, or to any novelty in principle, and to have excited no great influence on trained students. The author reviews Prof. Francis A. Walker's contributions to the discussion at considerable length, and maintains that they have never touched the essentials of the matter. Finally, while the controversy over the wages fund is acknowledged to be a barren one so far as it is an effort to define the causes which finally distribute wages and settle distribution at large, the author holds that something may still be gained from it as a mode of describing the methods and sequence of production and related points.

* Wages and Capital: An Examination of the Wages-Fund Doctrine. By F. W. Taussig. New York: D. Appleton & Co. Pp. 325. Price, $1.50.

Prof. *Hadley* describes his book on *Economics** as an attempt to apply the methods of modern science to the problems of modern business. As among the important changes in economic theory that have taken place within the last thirty years, he mentions the application, by different schools of investigators, of the principle of natural selection and of the results of psychological study to account for the aspects of the subject to which they may severally apply. But these things have combined to make the economic science of the present day very different from that which formed the basis of John Stuart Mill's presentation: "Meanwhile, new problems have been developing in modern business life; most conspicuously, perhaps, in connection with large investments of capital in factories and railroads. The time which elapses between the rendering of labor and the utilization of the products of labor is now so long that the work of the speculator has far greater importance than it had a generation ago. The size of the units of capital is so large that free competition often becomes an impossibility, and theories of economics which are based upon the existence of such competition prove blind guides in dealing with modern price movements. We have to study, far more closely than we once did, the effect of combinations upon the interests of the consumers on the one hand and the laborers on the other; to examine the results of meeting organizations of capital with organizations of labor, and of controlling them by special legislation, or by direct government ownership. We have to deal with socialism, not as the theory of a few visionaries who try to destroy property rights, but as a series of practical measures, urged by a large and influential body of men who are engaged in extending the functions of government." The endeavor is made to supply the lack of any general work in the English language dealing comprehensively with these problems of modern economics. The book is written for students who are thinkers and for men who are engaged in doing the world's work, and is hardly likely to be found adapted to superficial readers. The special subjects treated are Public and Private Wealth, Economic Responsibility, Competition, Speculation, Investment of Capital, combination of Capital, Money, Credit, Profits, Wages, Machinery and Labor, Co-operation, Protective Legislation, and Government Revenue.

Mr. *Thomas S. Blair*, taking up the question embodied in the second title of his book on *Human Progress*,* and finding the present state of knowledge inadequate to furnish an answer, reasons that the complexity of the facts of human experience has been too much for the philosophers, seeks for an instance of better results elsewhere, and finds it in the case of the successful man of affairs. In this book he undertakes to present the conclusions he has reached through the application of business methods to his subject. He supposes man himself to have become the chief agency in the furtherance of the Creator's scheme for his evolution, his efficiency as such being brought through the operation of his experience of the natural laws controlling his evolution, whereby he becomes acquainted with them and learns to assist in giving them free play. According to the author's philosophy, human knowledge is limited to the form of working hypotheses as guides of action, but is capable of indefinite expansion within its limitations, and includes a large scope of knowledge of objective realities; the knowledge of the actual existence of the basis of religious sentiment is as unequivocal, direct, and conclusive as the knowledge of our own existence, and thus religion is established on a rigidly scientific foundation; and the active principle in the scheme of human progrees is the impulse to satisfy wants, operating under a law of man's being, according to which the satisfaction of a want is followed by the emergence of a new want, which is normally of a higher order than the want which it succeeds. Confirmation of these conclusions is looked for in the provision which Nature has made for the satisfying of wants of various kinds and the awakening of higher ones. The statements of principles

* Economics: An Account of the Relations between Private Property and Public Welfare. By Arthur Twining Hadley. New York and London: G. P. Putnam's Sons. Pp. 496. Price, $2.50.

* Human Progress: What can Man do to Further it? By Thomas S. Blair. New York: William R. Jenkins. Pp. 573. Price, $1.50.

and the arguments are overlald with much verbiage, and this makes the book very hard reading.

The *Dictionary of Chemical Solubilities* of Prof. *Arthur M. Comey* (Macmillan, $5) was an undertaking German in laboriousness and American in enterprise, and the finished volume is a monument of able and persevering effort. Although this work is nominally limited to the inorganic substances, exceptions have been made by including in it CO_2, CO, CS_2, the carbonates, cyanides, ferrocyanides, etc. Prof. Comey acknowledges receiving much aid from the earlier dictionary of Prof. Storer, but he found the material that has accumulated since 1860, the limit of that work, to be far greater than that previously extant. Different results given by different observers have been set down in many cases, with the authority for each, as it would have been manifestly impossible to verify all such conflicting statements experimentally. Under each title the solubility of the substance in water is first given, the date being arranged chronologically in the longer articles. Then follow the specific gravities of the aqueous solutions, and also any data obtainable regarding their boiling points. Following this is the solubility of the substance in other solvents—first the inorganic acids, then alkali and salt solutions, and finally organic substances. While many of the rarer substances are disposed of in a couple of lines, some of the more important occupy several pages: thus ammonia has five and a fourth pages, glass over three and a half, potassium nitrate nearly as much, and sulphuric acid over four. In putting the material together many puzzling problems of nomenclature and arrangement had to be solved, but Dr. Comey's own practical sense has been supplemented by wise counsel, and when the user of the volume reflects that the dictionary plan can give the maximum of convenience only by sometimes disregarding logic and relationship he will agree that these questions have been well decided.

The University of the State of New York has issued Museum Bulletin 14 on the *Geology of Moriah and Westport Townships, Essex County*. Besides describing the general geology of these townships, this pamphlet gives the latest information on the important iron-ore deposits of that region, and reviews the probable hypotheses as to their origin. It contains a geologic map of the two townships, a map of Mineville iron region, and half-tone views of the mining district and sections of the ore bodies. The bulletin is mailed by the State Library on receipt of ten cents.

The Natural Science Association of Staten Island has performed a commendable service to local geography and history by publishing the collection of *Staten Island Names*, compiled by *William T. Davis*, and the accompanying map prepared by Charles W. Leng. Names for natural features of the island and the waters surrounding it, and for ferries, roads, and villages are included in the collection. With each name is given the location of the place to which it was applied, and in many cases a quotation from some old advertisement, deed, or map is added as authority. With some a legend connected with the place is inserted. The list makes a pamphlet of fifty-seven pages, which may be had for 50 cents from Arthur Hollick, secretary of the association, at New Brighton, N. Y.

A new and enlarged edition of *Hypnotism, Mesmerism, and the New Witchcraft*, by *Ernest Hart*, M. D., has been issued recently (Appletons, $1.50). The original edition was noticed fully in our number for October, 1893. Dr. Hart's general conclusions in regard to hypnotism are that it is very rarely useful for curative purposes, and is dangerous for platform performances and private amusement. In a new chapter entitled The Eternal Gullible, Dr. Hart gives the confessions of a professional "subject" who had appeared in performances with a number of well-known "professors" in London. An appendix contains some lively controversial letters contributed to the British press by Dr. Hart, Dr. Luys, and Prof. Sidgwick.

With this may be mentioned *A Study in Hypnotism*, by *Sydney Flower*, which is a story of a hypnotizer's courtship with one of his subjects (Psychic Publishing Co., Chicago).

Hypnotism and its Relation to Witchcraft, Ghostology, and Mind-cure is the subject of a lecture by *J. H. Fisher*, which is published as a pamphlet (Seymour & Muir Printing Co., Grand Rapids). Mr. Fisher expresses him-

self in a vigorous and humorous style, and brushes away the nonsense from the popular idea of hypnotism with an unsparing hand, exposing as he goes along many of the tricks of platform "professors." He maintains that good subjects, when not confederates, are hypnotized by their own faith in the power of the operator, that the healing by saintly relics and Christian science is due to just such faith, and that ghosts and witches have had their only existence in a similarly strong belief.

Hypnotism is treated more respectfully in a little pamphlet by Prof. *G. A. Keene* (the author, Masonic Temple, Chicago, 15 cents), who gives a general exposition of the subject, and firmly maintains its value in medicine and surgery. All of these publications except the second are illustrated.

The *Examination of Weismannism*, by Dr. *G. J. Romanes* (Open Court Publishing Co., 35 cents), consists of a series of essays discussing the phases of Weismann's theory of evolution as they have appeared in that investigator's successive publications. The first chapter is a statement of Weismann's system up to the year 1886, and the second supplies additions bringing it up to 1892. Then follow examinations of Weismann's theories of heredity and evolution as they stood in 1891, and a final chapter brings the subject up to 1893. From this discussion Dr. Romanes excludes the doctrine of non-inheritance of acquired characters, and deals only with "the elaborate system of theories which Weismann has reared upon his fundamental postulate." He represents these theories as being in a continual flux and change, and he had intended to add supplementary chapters to future editions of this book in order to keep pace with further developments which he expected to appear. In his opposition to Weismann, Romanes was largely on common ground with Spencer, but there were points upon which he took issue with the latter, some of which are set forth in an appendix. Another appendix contains certain supplementary suggestions on Weismann's theory of germ-plasm.

One important way in which the fingers of primitive man assisted his wits is impressed upon our attention by Dr. *Levi L. Conant's* study of *The Number Concept* (Macmillan, $2). The number systems of nearly all existing peoples evidently arose from counting on the fingers—some using one, some both hands, and others supplementing the fingers by the toes. Dr. Conant mentions, however, a few tribes who have numeral words only for one, two, and many, and some even whose only numeral seems to be one. He shows from a large number of numeral vocabularies that number words have been suggested in very many languages by the act of telling off the fingers in counting. Examples are words meaning "the end is bent" for 1, "the notched off" or "one hand" for 5, "one on the foot" for 11, and "one man" (all the fingers and toes) for 20. While most peoples have five or ten as their number base, a few have two, going on with words meaning two-one, two-two, etc. Four is also used as a base, but Dr. Conant has found no recorded instance of a number system formed on 6, 7, 8, or 9. It has been announced recently that the Aphos, an African tribe, have the best of all systems, the duodecimal, but the report has yet to be verified. The vigesimal system, either alone or combined with the quinary, appears in many places and persists even in the French *quatre-vingts*. The author believes that he has brought together for this discussion the largest existing collection of numeral systems.

Among the publications issued by the Sound Money League of Pennsylvania is No. 13, *A Dissatisfied Farmer*, which shows that most of the depression under which agriculture in the United States now labors is due to competition, and especially to the competition of the wholesale operations carried on in the West. The little pamphlet is illustrated with excellent photo-engravings showing old and new methods of agriculture, stock-raising, and transportation. (Room 248, The Bourse, Philadelphia.)

Under the title *The Union College Practical Lectures* there have been collected in a volume thirteen lectures delivered at Union College in a course instituted by General Daniel Butterfield. The plan of the course has been evidently to get men prominent in affairs to talk about their respective specialties to the students of the college. Thus the first lecture on the list is an account of the

Military Academy at West Point by General P. S. Michie, dean of the faculty of the academy, and the late A. H. Rice, ex-Governor of Massachusetts, gave Some Inside Views of the Gubernatorial Office. Six of the addresses were on public affairs; Henry W. Cannon spoke on Banking and Currency, Montgomery Schuyler on Architecture, Andrew Carnegie on Wealth and its Uses, while pure and applied science were represented by the lecture of Albon Man on Electricity, of General William A. Hammond on Brains and Muscles, of ex-Governor Alonzo B. Cornell on The Electro-magnetic Telegraph, and of Colonel F. V. Greene on Roads. The volume contains the portrait and a short biographical sketch of each lecturer. (F. T. Neely.)

The summary and index of *Legislation by States in 1895*, issued by the New York State Library (University of the State of New York, 35 cents), contains 4,847 entries. This bulletin, which has now been published for six years, is of great service in putting State legislators in possession of the recent work done in other States, and thereby promoting progress and uniformity. A new feature this year is a separate table of constitutional amendments arranged by States, showing the result of the vote on all amendments in 1894 and 1895, and giving also those to be submitted to future vote.

Having made a thorough lexicographic study of mineral names for the new dictionary of the Philological Society, Prof. *Albert H. Chester* has recently issued the results of his labors separately as *A Dictionary of the Names of Minerals* (New York: Wiley, $3.50; London: Chapman & Hall). He has aimed to give with each name its correct spelling, its author, a reference to its first publication, its original spelling, its derivation, the reason for choosing this particular name, and a short description of the mineral to which it belongs. In a few cases he was unable to determine one or more of these points, and he sends out with the volume a circular asking aid in securing the lacking information. Nearly five thousand names are included in the dictionary, and many of the facts concerning them are now given in a vocabulary for the first time, having been gathered from little known books or from private communications. A considerable number of imaginary derivations and other errors are corrected in this work. An introduction contains an interesting history of attempts to systematize mineralogical names, accounts of the introduction of some errors, and other similar matter. A list of works cited fills nineteen pages, and an index to the authors of mineral names occupies twenty-four more.

The Annual Literary Index, edited by *W. I. Fletcher* and *R. R. Bowker* (The Publishers' Weekly, $3.50), is an annual supplement to Poole's valuable index to periodicals and, by the addition of one feature after another, has become much more than that. The volume for 1895 contains besides the Index to Periodicals an Index to General Literature, which rather ambitious title denotes an index to the contents of one hundred and thirty or forty volumes of essays, biographical sketches, etc., published in 1895. There is an Author-index covering these two lists, which is followed by a list of the American and English bibliographies that have appeared (in treatises or separately) in the course of the year, a Necrology of Writers, and an Index to Dates of Principal Events. This last is a new feature, and besides its independent historical value it is practically an index to the files of any newspaper.

The second annual volume of MM. H. Beaunis and A. Binet's *Année Psychologique* (Psychological Annual) for 1895 is much larger than the first, and forms a book of 1010 pages. The volume, which is published from the Laboratory of Physiological Psychology of the Sorbonne, contains, under the heading of Memoirs of Collaborators, papers on Abnormal and Morbid Characters, by Prof. Ribot; A Glance at Comparative Psychology, by M. Fosel; An Experiment in Reading in which Certain Categories of Words are omitted, by M. Flourney; On Intellectual Phenomena, by M. Bererdon; A Note on the Conditions favoring Hypnotism, by M. Gley; and Illusions of Weight, by M. Biérnléct. Other papers are given under the headings Works from the Laboratory and General Reviews. The second part of the volume contains analyses of publications and papers that fills fourteen chapters, each covering its separate department, with subdivisions; four *Études d'ensemble*, or General

Studies, by Charlin, Maudsley, Morselli, and Wernicke; Necrological Notices; and a bibliography embracing 1,394 titles, with an index of authors—these credited to the Psychological Review. (Published in Paris by Félix Alcan. Price, 15 francs.)

Home Study is a new illustrated monthly intended for elementary students of the various engineering and architectural branches. Vol. I, No. 3, contains several interesting and instructive articles, among which may be mentioned Stability of Vessels, Electric Currents, Chokage of Drains, Foul Air of Rooms, The Modern Theory of Heat, and Circulating Decimals. (Scranton, Pa. $1.50; 15 cents.)

The Bamboo Garden, by *A. B. Freeman-Mitford* (Macmillan, $3), is an attempt to give a descriptive list of the hardy bamboos in cultivation in England, and to focus such information in regard to them as could be obtained from Japanese as well as from European sources. The methods of propagation, and choice of position and soil, are considered in the early chapters. Chapter IV deals with the manifold uses to which the bamboo is put, and the curious customs and superstitions connected with the plant in Eastern countries. The remainder of the book consists of a classification and description of species. A few illustrations accompany the text.

Press Working of Metals, by *Oberlin Smith* (New York: Wiley; London: Chapman & Hall), is a treatise upon the principles of shaping metals in dies, and a description of these dies, both those in present use and of past stages in the art of metal-working. The body of the work is prefaced by a short historical sketch on the probable origin of the art, and the crude methods which were at first employed. The book is essentially technical and of interest to only a special class. Good illustrations are quite numerous.

PUBLICATIONS RECEIVED.

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Alabama Geological Survey. Iron-making in Alabama. Pp. 164. Bulletin No. 5: A Preliminary Report of the Resources of the Upper Gold Belt. Pp. 202.

Baker, Marcus. The Alaskan Boundary. Pp. 16.

Bell, Alexander M. English Visible Speech in Twelve Lessons. Washington: (The Author.) Pp. 80. 50 cents.

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Fischer, P. D. Betrachtungen eines in Deutschland reisenden Deutschen (Reflections of a German traveling in Germany). Berlin: Julius Springer. Pp. 247. 3 marks.

Francke, Kuno. Social Forces in German Literature. New York: Henry Holt & Co. Pp. 577.

Hay, O. P. On Some Collections of Fishes and on The Skeleton of Soxochelys Latiremis. Field Columbian Museum Publications. Zoölogical Series. Vol. I. Nos. 4 and 5.

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Hill, D. J. An Honest Dollar the Basis of Prosperity. New York: The National Republican Executive Committee.

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Revista da Sociedade de Geographia do Rio de Janeiro (Review of the Geographical Society of Rio de Janeiro). Vol. XI, 1895. Rio de Janeiro: Leuzinger. Pp. 110.

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liminary Description of a New Genus and Three New Species of Crustaceans from an Artesian Well at San Marcos, Texas.—1088. Description of a New Genus and Species of Blind Tailed Batrachian from the Subterranean Waters of Texas. —1089. Description of a New Stickleback from the Coast of Maine.—1090. Description of a New Species of Ant Thrush from Nicaragua.—1091. Partial List of Birds collected at Altamira, Mexico, by F. B. Armstrong.—1092. On Some Prepared Parasitic Hymenopterous Insects from Ceylon.—1093. An Annotated List of Birds observed on Margarita Island and at Guanta and Laguayra, Venezuela.—1094. List of Coleoptera collected on the Tana River and on the Jomboni Range, East Africa.

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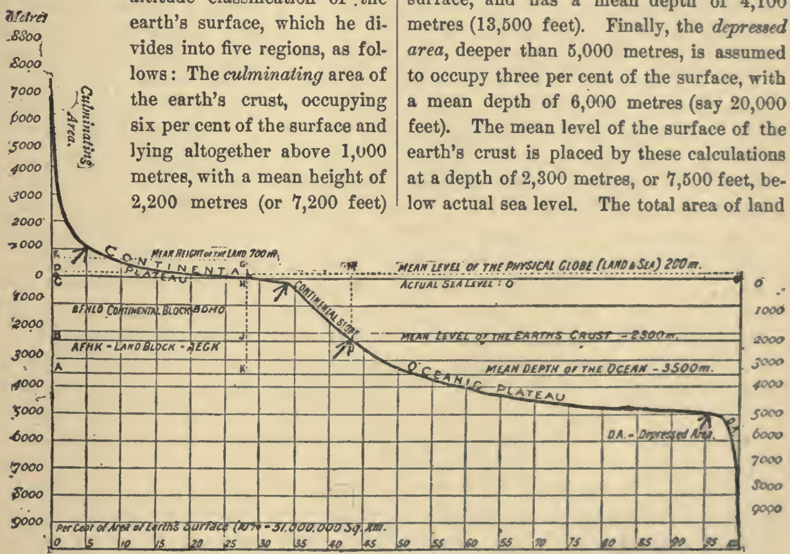
Fragments of Science.

A New Classification of Elevation Areas.—Prof. Hermann Wagner, of Göttingen, one of the best-known geographers and statisticians of Germany, has recently published a new altitude classification of the earth's surface, which he divides into five regions, as follows: The *culminating* area of the earth's crust, occupying six per cent of the surface and lying altogether above 1,000 metres, with a mean height of 2,200 metres (or 7,200 feet) above the sea. The *continental plateau*, occupying all the surface from the 1,000 metre contour line of elevation to the 200 metre contour line of depth—i. e., to the margin of the shallow sea border or continental shelf; it comprises 28·3 per cent of the surface, and has a mean elevation of 250 metres (800 feet) above the sea. The *continental slope*, from a depth of 200 metres to 2,300 below sea level, covers nine per cent of the earth's surface, and has a mean depth of 1,300 metres (4,300 feet). The *oceanic plateau*, between the depths of 2,300 and 5,000 metres, occupies no less than 57·3 per cent of the surface, and has a mean depth of 4,100 metres (13,500 feet). Finally, the *depressed area*, deeper than 5,000 metres, is assumed to occupy three per cent of the surface, with a mean depth of 6,000 metres (say 20,000 feet). The mean level of the surface of the earth's crust is placed by these calculations at a depth of 2,300 metres, or 7,500 feet, below actual sea level. The total area of land is worked out at 28·3 per cent and that of sea at 71·7 per cent of the earth's surface; the ratio of land to water surface is thus 1 : 2·54. The accompanying chart is reproduced from Nature of June 4th.



Wagner's Hypsographic Curve.

Silk from Wood.—According to the London Times, there is growing up in France a considerable industry, based on the manufacture of a so-called silk from wood pulp.

The works are at Besançon, and utilize a process devised by M. de Chardonnet, which is as follows: The pulp, thoroughly cleansed and looking very much like thick gum, is put into cylinders, from which it is forced through pipes into the spinning department. Here the machinery is very similar to that of the ordinary spinning shed, except that one of these pipes passes to each machine. The pipes are supplied with small taps, fixed close together, and each tap has a glass tube about the size of a gas burner, at the extreme point of which is a minute aperture, and through this the pulp is forced. These glass tubes are called the silkworms, and some twelve thousand of them are in use in the factory at Besançon. The pulp appears as a minute globule. This a girl touches with her thumb, to which it adheres, and she draws out an almost invisible filament, which she passes through the guides and onto the bobbin. Then, one by one, she takes eight, ten, or twelve other such filaments, according to the thickness of the thread to be made, and passes them through the same guides and onto the same bobbin. The subsequent details are practically those of ordinary natural silk spinning. The chief difference in appearance between the natural and the artificial silk is in the greater luster of the latter. The new product is said to take dye much more readily than the natural silk, but not to be quite so strong. It is stated that a factory for the manufacture of this material is to be erected near Manchester, England, which will cost $150,000.

Old Madagascar War Customs.—Descriptions of curious war customs that prevailed in Madagascar are quoted by M. A. Grandidier from Mayeur, who visited that country in 1785, or more than a hundred years ago. The hostile bands usually agreed on the day and place of the battle, and at the appointed time the opposing parties marched to the designated spot. When all was ready, some of the soldiers of one host advanced, fired their guns, and ran back to the protection of their army. While these were reloading, the soldiers on the opposite side went through the same manœuvre; and this was continued till one of the hosts got so much the worse of the fight that it retired. Both armies would then go home and return to the occupations of peace, to resume their odd hostilities at some future time. The first battle that Mayeur witnessed lasted from ten o'clock in the morning till four o'clock in the afternoon, with twelve thousand soldiers in line, without victory to either side, while there were twenty-two killed and wounded. Ten days afterward, one of the chiefs having obtained re-enforcements, the fight was resumed and hotly contested till, in the very thickest of it, a cloud of locusts suddenly darkened the sky and alighted on the neighboring rice fields. Firing was stopped at once, and all the combatants went pell-mell to picking the destructive insects, of which they were very fond as food. Women, children, and old men hurried out of the villages, where they had hidden themselves, and mingled with the soldiers; and in less than a quarter of an hour the plain was covered with more than twenty thousand people, squatting on all fours and capturing the insects. It was the custom, M. Grandidier observes, to suspend hostilities in the presence of a plague, which, as the king said to Mayeur, threatens a whole people, while war generally interests only the chief who makes it.

The Year's Polar Expeditions.—Dr. Frithiof Nansen, who started from Christiania, Norway, in June, 1893, in the little vessel Fram, to reach the north pole if possible, has returned, after having attained latitude 86° 14′ north, within about two hundred and fifty miles of the pole, the highest point yet reached. (An excursion twelve miles farther on *ski* is also mentioned.) Dr. Nansen started with the expectation of meeting a current in which his vessel would be borne along with the ice to the pole and past it, basing the expectation on information which has since been found to be false. The Fram was constructed in a peculiar manner, so that when it met the heavy ice it should be lifted up and borne upon it instead of being crushed by it. In latitude 78° 50′ north, longitude 138° 37′ east, and in the latter part of September, 1893, the ship was allowed to be closed in by the ice, and was then drifted north and northwestward during the fall and winter months. A sudden increase in the depth of the water at latitude 70° to from sixteen hundred to nineteen hundred fathoms seems, according to Dr. Nansen, to upset the theories

that are based upon a shallow polar basin. The sea bottom was remarkably devoid of organic matter. Under the surface of cold ice water covering the polar basin warmer and more saline water was found, probably from the Gulf Stream. No land and no open water, except narrow creeks, were seen. A few days after Christmas, 1894, the Fram was at latitude 83° 24′, the farthest north that had been reached. Dr. Nansen here left the ship, taking Lieutenant Johansen with him, to explore the sea farther north. He reached his highest point on April 7, 1895, and, finding the prospect of a further advance discouraging, started on his return journey the next day. He reached Franz-Josef Land June 7th of this year; was embarrassed to find Payer's map all wrong; and, after sailing and paddling around for several weeks in the supposed direction of Spitzbergen, met the steamer Windward. Leaving Franz-Josef Land in this vessel, August 7th, he and his companion were brought by a short and very pleasant passage to Vardöe, Norway. The Fram, which Dr. Nansen left in charge of its master, Captain Sverdrup, returned safely to Norway only a few days after Dr. Nansen's arrival. Persons best informed in arctic research affirm that the expedition has made many and valuable discoveries.

An expedition of eminent explorers, among whom are Sir W. Martin Conway and Mr. Trevor Battye, which started out to cross Spitzbergen and explore its interior, has successfully accomplished its purpose. M. Andrée, who went to the polar regions for the purpose of attempting to reach the pole by balloon, found himself constantly baffled by opposing winds, and has returned, having been obliged to give up the attempt for this year.

Poisonous Spider Bites.—It has always been questioned whether the bites of the spiders of the temperate zone were ever fatal. Popular belief has it that they sometimes are, but spider students generally scout the notion. A few cases have recently been cited, however, on testimony which can hardly be doubted, that point to an affirmative answer. An account is given in Dr. Riley's Insect Life of a man in excellent health who died fourteen hours after having been bitten in the neck by the species *Latrodectus mactans.* He instantly felt an intense pain, and picked off from the wound a spider of the species named. Four hours afterward the spot was marked by a circle of little white pimples about as large as a silver half dollar, but the wound itself was not seen; and, while there was no swelling, the neck and left arm were rigidly hard. Violent pains ensued, reaching the intestines, but the sufferer was able to go to the village for whisky and back, after which spasms set in. Six cases of spider bites, observed by M. Corson de Savannat, were followed by serious but not mortal effect. The identity of the conditions under which the bites were received and the similarity of the observed symptoms give the cases resemblance to real laboratory experiments. All suffered great pains in the abdomen and back and tetanic contractions lasting several hours, with dyspnoic respiration and rapid, strong pulse. The patients' condition appeared desperate without its being possible to define any particular local pain. The cases were treated with injections of chlorhydrate of morphine and internal stimulants. Similar nervous troubles and contractions were marked in 1833 by M. Graells, of Barcelona, as following bites by the *Latrodectus mamigniatus.* In some cases a rash is mentioned as breaking out in a few hours either in the region around the bite or over the whole body. A spider whose bite is regarded as fatal is found on the seashore of New Zealand. The symptoms following the bites of these spiders are described by the New Zealand doctors as like those consequent upon the action of narcotics, while those produced by our northern spiders are rather convulsive.

Alaska.—Mr. W. H. Dall, in his paper on Alaska as it Was and Is (1865–1895), describes the region which includes the Aleutian chain and other islands west of Kadiak as presenting a striking contrast "to the densely wooded mountains and shining glaciers of the Sitkan region to the east and the rolling tundra, cut by myriad rivers, in the north. Approached by sea, the Aleutian Islands seem gloomy and inhospitable. Omnipresent fog wreaths hang about steep cliffs of dark volcanic rock. An angry surf vibrates to and fro amid outstanding pinnacles, where innumerable sea birds wheel

and cry. The angular hills and long slopes of talus are not softened by any arborescent veil. The infrequent villages nestle behind sheltering bluffs, and are rarely visible from without the harbors. In winter all the heights are wrapped in snow, and storms of terrific violence drive commerce from the sea about them. Once pass within the harbors during summer and the repellent features of the landscape seem to vanish. The mountain sides are clothed with soft yet vivid green, and brilliant with many flowers. The perfume of the spring blossoms is often heavy on the air. The lowlands are shoulder high with herbage, and the total absence of trees gives to the landscape an individuality all its own. No more fascinating prospect do I know than a view of the harbor of Unalashka from a hill top on a sunny day, with the curiously irregular, verdant islands set in a sea of celestial blue, the shore lines marked by creamy surf, the ravines by brooks and waterfalls, the occasional depressions by small lakes shining in the sun. The sea abounds with fish; the offshore rocks are the resort of sea lions, and formerly of sea otters; the streams afford the trout-fisher abundant sport, and about their mouths the red salmon leap and play. In October the hillsides offer store of berries, and in all this land there is not a poisonous reptile or dangerous wild animal of any sort. The inhabitants of this land are an interesting and peculiar race."

The Underground Houses of Techin, Tunisia.—The curious underground houses of Techin, and other places near Gabes, in Tunisia, are described by M. Albert Tissandier, in *La Nature*, as being easily cut out of the clay-limestone rock. A square pit, twenty or twenty-five feet deep, is generally dug first to form a central court, from the lower part of which are made the grottoes that serve as sleeping and store rooms. A gently sloping gallery rising from the level of the bottom to the level outside, and closed by a modern door, is the means of communication with the country without, or forms a path to other houses. Niches are cut in the walls of the entrance court for storage of the agricultural implements and things of minor value, and silos are provided for the grain crops and oil jars. The rooms are lighted only through the doorway from the entrance court. They are furnished with mats and carpets. A bed and a wooden pedestal for the lamp, rudely carved and whitewashed like the walls of the cavern, form the principal ornaments, and a few primitive utensils of enameled earthenware are the principal articles of furniture. The size of the house and the number of rooms, etc., vary according to the wealth and station of the proprietor.

A Measure for Odors.—Very interesting studies have been made by M. Eugène Mesnard of the perfumes of flowers, valuable to science and to the perfumer's art. This art is still in a rather crude state because it has never found a practicable way of measuring an odor or of determining the strength of the several odors which it may seek to combine. M. Mesnard has observed, however, that though the absolute intensity of an odor can not be measured, its comparative strength can be estimated. A perfumer who has five or six hundred kinds of fragrance in his shop can readily distinguish the differences between them, although he can not tell how strong any of them are. So it is possible to detect by the smell the existence of a large number of chemical substances, although it is impossible to guess how much, if any, of them may be present in the air. Suppose, now, the author says, we pass in a given receiver air charged with a known perfume and air which has passed over a special essence—spirits of turpentine, for example. It is possible to obtain in this way a mixture of neutral odor, or such that a very slight variation of its constituents on either side will cause the special odor of the perfume or the smell of the turpentine to prevail. We can in such case regard the two odors as equivalent, and have only to seek a means of determining the intensity of the turpentine odor to have a measure of that of the perfume. A measure for the turpentine is obtained by means of the property which it has of extinguishing the phosphorescence of phosphorus. For that purpose a bit of common starch is employed which has been dipped in a sulphide-of-carbon solution of phosphorus. The sulphide evaporates and the starch remains, a homogeneous substance impregnated with phosphorus which shines in the air. The

shining may be extinguished, as M. Mesnard has shown, by the introduction of a quantity of air inversely proportioned to the strength with which it is charged with turpentine. Spirit of turpentine may thus be made a common standard for the different essences, and we may regard as the measure of the intensity of the perfume disengaged by a given weight of an essential oil the ratio between the weight of the turpentine which will neutralize the perfume and the weight of the same substance which under corresponding conditions will act upon phosphorescence with corresponding energy. M. Mesnard has devised an ingenious apparatus for performing practical measurements by the application of this principle.

Cordite.—According to the Industrial World, the manufacture of cordite is very simple. Nitroglycerin and dried gun cotton are mixed together in accurately weighed portions, the liquid nitroglycerin being poured over the gun cotton and mixed by hand until it is all taken up by the cotton, producing a dirty-white mass which looks much like sugar. This mass is then placed in kneading machines, which mix in the proper proportion of acetone. After several hours' kneading some vaseline is added and mixed in by further kneading. The mass finally becomes a stiff dough, which can be readily molded into any desired shape. The combination of nitroglycerin and gun cotton with acetone produces a compound quite different in appearance and properties from either of its components. Cordite is a heavy substance which burns only on the surface, the violence of whose explosion can hence be readily regulated by varying the relation between surface area and volume. Both nitroglycerin and gun cotton are very unstable. Cordite, on the other hand, is quite the reverse. Thus, a bonfire made around eight cases piled up against each other simply burned up the boxes and then the cordite, no explosion occurring.

Death of Prof. Ernst Curtius.—Dr. Ernst Curtius, Professor of History and the Fine Arts in the University of Berlin, who died July 12th, aged eighty-one years, was one of the most distinguished and most learned historians and archæologists of the century. He was born at Lübeck in 1814, of a family distinguished by love for literature and art; studied at Bonn, Göttingen, and Berlin; went with Prof. Brandeis in 1837 to Greece on an errand for the furtherance of archæological research; afterward, with Ottfried Müller, spent four years in Greece in historical and archæological studies, and began in 1864, but carried on with great activity after 1875, the excavations at Olympia which have been rewarded with the richest and most abundant treasures of classic art. From 1844 to 1849 he was extraordinary professor at the University of Berlin and tutor to the crown prince. In 1856 he was elected professor at Göttingen, but returned to Berlin as professor in 1868. His History of Greece is rivaled in merit only by Grote's, and is its fitting complement, supplying what Grote's lacks as Grote's supplies what it lacks, and is distinguished by the life it gives to the old legends and its appreciation of the artistic genius of the Greeks. He also published—works of equal merit in their respective fields—a book on the Acropolis of Athens (1844) and an account of the Discovery of Olympia (1882), besides many smaller works and monographs.

Plant Breeding.—In a recent copy of Nature M. T. Masters has an interesting article on Plant Breeding, from which the following extracts are taken: The natural processes of variation in the plant world as controlled by the art of the gardener are well typified in the garden rose of to-day—quite a different flower from those roses of our forefathers, which have, with a few exceptions, totally disappeared. It is the same with peas and potatoes and with most other plants that are grown on a large scale. The two methods made use of by gardeners for the improvement of plants are selection and cross-breeding, the latter, as far as results are concerned, only a modification of selection. The natural capacity for variation of the plant furnishes the basis on which the breeder has to work, and this capacity varies greatly in degree in different plants, so that some are much more amenable and pliant than others. The trial grounds of our great seedsmen furnish object lessons of this kind on a vast scale. The two processes are antagonistic. On the one hand, every care is

taken to preserve the breed and to neutralize variation as far as possible, so that the seed may "come true"; on the other hand, when the variation does occur, the observation of the grower marks the change, and he either rejects the plant, manifesting it as a "rogue," if the change is undesirable, or takes care of it for further trial if the variation holds out promise of novelty or improvement. Where the flowers lend themselves readily to cross-fertilization by means of insects, it is essential, in order to maintain the purity of the offspring to, grow the several varieties at a very wide distance apart. Some apparently slight variations, which even to the trained botanist are hardly noticeable, may be of great value commercially; as, for instance, of two apparently almost identical varieties of wheat one may be much better able to resist mildew and diseases generally than another. Some, again, prove to be better adapted to certain soils or for some climates than others. Some are less liable to injury from predatory birds, and so on. So far we have been alluding to variations in the plant as grown from seed, but similar changes are observable in the ordinary buds, and gardeners are not slow to take advantage of these variations. The field is one of great scientific as well as commercial interest, and a thoroughly equipped biologist would probably soon distance the ordinary gardener, who works by rule of hand, in producing and perpetuating valuable variations.

Some African War Customs.—When war comes to the Bondei people in Africa, the Rev G. Dale, missionary, says, the first who hears it climbs up to the top of the house and beats the drum with one hand, calling the people to assemble there. A drum is beaten in every village as soon as another drum is heard. Everybody goes where the first drum was sounded, and the people cry war all over the country. All the women and children go into the forest with their property, taking especial pains to carry the basket containing the money and beads. The warriors take their weapons, put their amulets on their arms and neck and face, and adjust their ostrich plumes. Each one supposes that the charms will keep him safe, and have power, even if he is struck with a bullet, to prevent its entering him. Another charm consists in scarifying the man all down his arms and breast and back, after which, it is believed, no sword will cut into his body. The great doctors have a powder which they put into water, which the warriors drink. On approaching the seat of war the warriors assemble, when every one is smeared on the face with a certain preparation and given medicine, and is licked by the *fundi.* Then they separate; each band goes in its special direction, and the battle takes place. If they conquer they return together singing songs signifying, "As the *kishundu* is a great bird and is accustomed to the mountains, so we are accustomed to war"; or, "Come and live in our land. That yonder is glowing with the fire of burned villages. We are like the Masai"; and entering the village they shout, "The land is at rest, till and eat!" If a man has been killed, they return singing, "My millet has a limit, who has eaten it?"—go to the house of the dead man, fire their guns, and take away the grass that slopes over the door—and so the wife knows that she is a widow. Then they go and tell the old folks. The man who has killed an enemy in battle performs a ceremony for seven days which includes climbing to the top of the house every morning, boasting, and naming the man he has killed. If the warriors are defeated, they come back one by one, having hidden themselves. In case of victory the women greet the warriors with great joy, and shave, for the first time since their husbands went to war.

Paints for Iron.—A new study of paints for iron has led Herr Spennrath to the conclusion that none of the metallic oxides entering into the composition of paints combines chemically with the oil. The drying of the paint is caused solely by the absorption of oxygen by the oil, which is facilitated in a purely mechanical way by the presence of the oxide. The relative value of the oxides is very variable. Oxide of zinc, when used in outside work, swells rapidly to twice the original volume, in consequence of the absorption of carbonic acid and the vapor of water. The red and white oxides of lead absorb sulphureted hydrogen and increase in volume. These substances are, however, good driers when they are pure. Carbon

paints are very stable, but their protecting power is not great. Herr Spennrath has attempted to explain the duration of different paints by means of comparative experiments on sheets of zinc. The painted zinc was dissolved in an acid, and films of paint were obtained and subjected to various tests. All were rapidly destroyed by the action of dilute hydrochloric or nitric acid, and of the vapors of sulphuric and acetic acids. Alkaline vapors likewise destroyed them rapidly. Pure water acts more rapidly than salt water, which goes to prove that corrosion by sea water is rather an effect of mechanical washing than of chemical action. Temperature, too, has a considerable influence on the resistance of paints. The films became brittle at a temperature of 95° C., and a perceptible contraction of the layer took place. Similar effects were produced on paints exposed for a long time to a low temperature.

August Kekulé.—August Kekulé, Professor of Chemistry in the University of Bonn, who died July 13th, sixty-six years old, left his mark on the science of chemistry in a distinct advance to which he gave the impulse. He was born at Darmstadt, in 1829, went to school there, and was then sent to Giessen, under the expectation that he would be educated to become an architect. But Liebig was at Giessen, and Kekulé's attention was turned to chemistry. Returning to Darmstadt, he studied chemistry under Moldenhauer, and then entered again as a student at Giessen under Liebig and Will. He afterward studied in Paris; sojourned for a short time in Switzerland as assistant to Von Plantu, at Reichenau; was engaged at St. Bartholomew's Hospital in London; established a laboratory, where he received pupils, at Heidelberg; and became professor, successively, at Ghent and Bonn. Kekulé's services to chemistry were chiefly in the theoretical field. The twenty-fifth anniversary of his promulgation of the benzene theory was celebrated at Berlin, in 1890, and the twenty-fifth anniversary of his professorship at Bonn, in that city, two years later. He took up Frankland's theory of valency and elaborated it; laid the foundation of the study of constitutional chemistry; gave the start to the fruitful investigation of the carbon compounds; and pointed the way to thousands of important experiments and was the inspiration of hundreds of valuable discoveries.

Drawing Upside Down.—Observations of children drawing upside down have been collected by Mr. Rina Scott, who says, in Nature, that a great many children draw in this way, while many from the first draw the right way up. He relates that a boy of four, when asked to draw a rook on a haystack, began at the bottom of the paper with the rook's back, and gradually worked his way up to the haystack; then turned the drawing round and asked his observer to look at it—evidently realizing that it was inverted. Mr. Scott does not find the explanation of the peculiarity in any inversion of the retinal image; for, if a child who draws upside down when drawing on a horizontal table, is asked to draw on a blackboard placed vertically, he will draw everything the right way upward. He supposes that when the object seen on a vertical plane is to be represented on paper placed in a horizontal plane—in which there is already a considerable divergence from the real appearance—it is simply a matter of convenience to him at which end he begins—both being equally wrong from his point of view. So children sometimes look at picture books upside down, and small children are more ready to draw objects which they have been accustomed to see in a horizontal plane, than erect objects. Mr. Alfred W. Bennett relates that he has been able all his life to read easily a book upside down, so that it makes no difference to him which way the book is presented. This is because, as he has been told, he first learned to read, upside down, by standing in front of a brother and looking over the top of the book from which he was being taught to read. The facility curiously extends to books in foreign languages, even those in which other alphabets—as Greek and Hebrew—than the Roman are used, and to nearly the same extent to handwriting. In a similar connection Mr. Hiram M. Stanley speaks of a strong native tendency in some children—and he might have added adults, for we have seen sign-painting in which that style was present—to reverse right and left in drawing such letters as J and L. He compares this confusion, and probably is

right, with the confusion of right and left which one first feels on using a mirror for toilet purposes.

School Conditions and Eyesight.—Dr. Brudenell Carter has taken up the question of the effect of school conditions on the eyesight, particularly as to whether they develop and aggravate short-sightedness and the other defects of vision which have been charged to them. He examined 8,125 children in twenty-five elementary schools of London. In forty per cent of them the eyes were right. The others were subjected to further special examinations. The author reports, as the general result of his investigation, that the proportion of cases of myopia was small, and that it bore no relation whatever to the lighting of the school; the two schools in which the greatest proportions of defective visions were found being respectively the best lighted and the worst lighted of the whole number. No evidence was found of progressive myopia. Some of the worst cases were found among children who had recently joined school, and there was nothing to show that it increased with the length of time the children had been at school. The proportion of cases of astigmatism was less than the proportion discovered in Dr. Carter's private practice among patients examined for every kind of optical weakness. The vast majority of optical defects were due to hypermetropia. The most unexpected result of the investigation was the discovery that a very large proportion of the cases of defective vision were due, not to structural defects in the refractive combinations of the eye, but to imperfect practice in seeing. Comparing the vision of children at a country school with the cases in the town schools, the author found the country vision much better. It is inferred that vision is strengthened by the habit of looking at objects at a distance, which are presented far more frequently in the expanses of rural landscapes than in the street-bounded sights of the town. Dr. Carter recommends that the vision be tested and trained systematically; that it be included among the physical faculties that are tested by competition and for proficiency in which prizes are given.

MINOR PARAGRAPHS.

The recent death of Lord Lilford, Thomas Lyttleton Powys, at the age of sixty-three, has removed one of the most devoted and conscientious of English ornithologists. He was interested in natural history from his earliest years, and was President for many years of the British Ornithologists' Union. His collection of live animals at Lilford Hall was widely celebrated. At the time of his death—which occurred at Lilford Hall on the 17th of June—he was engaged on a large work on the Birds of the British Islands.

Geology has sustained a severe loss in the death of Sir Joseph Prestwich, which occurred on June 23d. He was born at Clapham on March 12, 1812. He was engaged in business in London until sixty years of age, but during this time was able to gain such a reputation among geologists that upon the death of Prof. Phillips he was elected to the chair of Geology in the University of Oxford. His work as a pioneer in establishing the geological antiquity of man was recognized by the Royal Society in awarding to him a Royal medal in 1865. He continued to be a prolific writer up to the time of his death. Although he belonged to the old school of "catastrophists" which Sir Charles Lyell opened war on in 1830, and which to-day is a rapidly decreasing minority, he did much valuable and lasting work.

An ingenious method of destroying cattle ticks is described by Dr. M. Francis, a veterinarian of the Texas experiment station. After several unsuccessful attempts to destroy the ticks by various other means, the dipping process was adopted, and after trying several carbolic and arsenical solutions with unsatisfactory results, the cattle were forced to swim through a large vat of five thousand gallons capacity, on the surface of the water in which was a layer of cotton-seed oil, from three quarters to one inch in thickness, so that when they emerged they were perfectly covered with oil. It is well known that grease or oil of almost any kind is fatal to insects, lice, etc., and the above treat-

ment was found to be exceedingly fatal to the cattle tick, while in no way injuring the cattle.

It is reported that Dr. William W. Jacques, of Boston, an electrician and chemist, has succeeded in devising a practical commercial process for converting the energy contained in coal directly into electricity. His battery is constructed as follows: In an iron pot is placed caustic soda and heat applied up to 300°, when fusion occurs; into this fused mass is plunged a stick of carbon, and then air is forced through the solution. By the contact of the air with the carbon stick, in presence of the fused soda, oxidation is produced with no deterioration of the electrolyte, and upon connecting the carbon stick and the iron pot by means of a wire, an electric current is generated.

Electric tanning is thus described in the Journal of the Franklin Institute: The tanning pit has a capacity of fifteen thousand litres and is about eighty inches broad and ten feet long. Electrodes of nickeled copper are fixed to the longer walls of the pit, and in the latter the hides are so suspended that the current has to pass right through them. A current of twelve ampères with an E. M. F. of twelve volts is used. The tanning matter consists of oak extract, with a little hemlock extract added, both of which are cleared and decolorized by a special electrolytic process. By these means Folsing states that he has succeeded in obtaining good leather in seventy-two hours from light cowhides, in five days from heavy cowhides, and in six days from heavy oxhides.

A book by M. Georges Viret, on Legislation and Jurisprudence concerning useful and injurious insects and insectivorous birds, suggests some curious questions. In it are found the conditions under which bees are personal property, and others under which they are real. When bees are sent by mail, should they be classified as specimens or as letters? The French law says as letters, and our own postal laws have special provisions for packages of this sort. We learn from the book that when bees go astray on another man's land they are not trespassers, unless they are peculiarly malicious, and go about stinging or do some harm to men and animals. A question is suggested by the provision in French law which makes stealing bees in the daytime a smaller offense than stealing them in the night, the penalty being considerably more severe in the latter case than in the former. Possibly the law depends on the bees to do part of the punishing of the daytime thief. The table of contents of M. Viret's book shows that the law takes notice of nineteen kinds of insects, among which are bees, caterpillars, Colorado beetles, ants, wasps, beetles, cattle flies, olive flies, botflies, phylloxera, the woolly aphis, vine pyralis, grasshoppers, grubworms, and silkworms. Most attention is given to the phylloxera.

Mr. F. W. True, in the Proceedings of the National Museum, describes an armadillo of the genus *Xenurus* received from Honduras. He says: "This is the first instance, so far as I am aware, in which any representative of this genus has been found in Central America. . . . The head is short and blunt, and the extremity of the snout entirely naked for a distance of sixteen millimetres. The cephalic shield consists of about thirty-eight comparatively large plates. The ears are margined with a row of small, rounded scales, but otherwise entirely naked. The feet and outer side of the legs are covered with somewhat scattered flat, orbicular scales. The tail has similar flat scales about a millimetre and a half in diameter, imbedded in the skin at regular intervals; from the posterior margin of each scale one hair is exsected. Total length, one foot five inches; tail, six and a half inches. I have little hesitancy in referring this Honduras specimen to the *Dasypus* (*Xenurus*) *hispidus* of Burmeister."

The International Conference organized by the Royal Society to consider the preparation and publication of an International Catalogue of Scientific Literature was opened in London, July 14th. The efforts of the Royal Society to form a record and index of scientific literature date from the middle of the century, when the great authors' index was begun. A subject index to follow the authors' index was decided upon about thirty years ago, but was not started till 1893. As it soon became evident that the Royal Society alone was not competent to accomplish so large a work, the movement to secure international co-

operation was begun about two years ago. It has happily secured the support of governments and scientific societies in all parts of the world, and the meeting is very widely representative. The United States is represented by Dr. John S. Billings and Prof. Simon Newcomb; Canada by the Hon. Sir Donald A. Smith; and Great Britain by a large number of its most distinguished scientific men. Sir John A. Gorst, the British Government representative, was chosen president. Prof. Newcomb is one of the vice-presidents. The proceedings of the conference will be in English, French, and German, as the official languages.

NOTES.

It is stated that in Como, Italy, arrangements are being made for the holding in 1899 of an electrical exhibition and congress, to commemorate the centenary of the invention of the voltaic battery. Alessandro Volta was born in Como in 1745, but it was while Professor of Natural Philosophy at the University of Pavia that he made the discoveries that have immortalized his name.

The result of an inquiry made by the directors of the German telegraphs into the effect of the network of telephone wires in the large cities has been, according to *Das Wetter*, to show that the presence of the wires tends to reduce the violence of thunder and to diminish the dangers from lightning.

Probably the earliest known example of piece-molding among European bronze foundries is a mold for a spear head which was found at Thonon, France, among the relics of the lake-dwellers. It is described by Mr. George Simonds as having been composed of two slabs of stone, on each of which a spear head was cut out to a proper depth. The two stones, being placed face to face and bound together, would form a very simple but close mold from which many casts could be taken without injury to the mold itself.

It is stated by Mr. F. T. R. Carulla (England) that no effective remedy has yet been found for preventing the rusting of outdoor iron and steel work, and that in new railway lines iron and steel bridges are excluded wherever practicable. He stated, for instance, that over twenty tons of rust were taken from the Britannia Bridge during the first sixteen years after its completion.

A trial for larceny is mentioned in the Green Bag as having recently taken place in Ohio, in which the detective work of a dog was put in evidence. Some of the stolen property was found near the scene of the theft and was shown to the dog; he was then shown footprints close to it. Then, being put on the trail, he followed it unhesitatingly about two hundred feet to a gate, then inside the gate up to two front outside doors, of which he chose the left-hand one, and inside to the prisoner's door. He had been trained to this business, and could trail a culprit thus even along a track twenty or forty hours' old. The evidence was admitted.

The special commission appointed by the International Meteorological Congress in Munich in 1891 for the organization of observations on the direction of movement and the height of clouds having completed its work, observations were to be begun in all parts of the world on the 1st of May last, and are to be continued one year. The classification of clouds proposed by Hildebrandsson and Abercromby will be nsed as far as possible.

The death is announced, June 17th, of Lord Lilford (Thomas Lyttleton Powys), an eminent English ornithologist, in the sixty-fourth year of his age. He had a famous collection of wild animals, particularly full in the group of cranes, at his estate of Lilford Hall, and in knowledge of the habits of wild creatures, especially of birds, "had few equals." He was President of the British Ornithologists' Union, was a frequent contributor to The Zoölogist and The Ibis, was author of the Birds of Northamptonshire, and had nearly completed a book of Colored Figures of the Birds of the British Islands.

Dr. Heinrich Ernst Beyrich, Professor of Geology in the University and Director of the Natural History Museum in Berlin, recently died there, in his eighty-first year. He was a younger brother of the famous chemist, Ferdinand Beyrich, who died in 1869, and "was a most inspiring academical teacher, and gave a lively impulse to geological research." He published many papers on geology and paleontology, and was chief in making the geological map of Prussia and the Thuringian states.

Sir William Grove, an eminent lawyer, but most eminent as a man of science, died in London, August 1st. He was born at Swansea in 1811; was graduated from Oxford in 1830; was called to the bar in 1835, but, being in ill health, devoted himself to electrical researches, and in 1839 contrived the powerful battery that bears his name. By this and his researches on the conservation and transformation of energy he was best known. He was one of the original members of the Chemical Society, and was President of the British Association at the Nottingham meeting in 1866. A sketch of him, with portrait, was given in the Popular Science Monthly for July, 1875 (vol. iii, p. 363).

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